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DAS Data Requirement 14

Analysis and Inspection Report for the Demand Access System (DAS)

DRAFT

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the results of the analysis and inspection verification performed to support the System Qualification of the Demand Access System (DAS).

1.2 SCOPE

This report addresses the DAS SRD [1] requirements that are verified by either 'analysis' or 'inspection', as designated in the DAS Performance Verification Matrix (PVM) [2]. The scope of these inspections and analyses includes all DAS subsystems, internal interfaces between these subsystems and external DAS interfaces (i.e., WSC equipment, Space Network Web-based Services Interface (SWSI) and the NASA Integrated Services Network (NISN) IP Operational Network (IONet)), as outlined in Section 3 of the DAS Acceptance Test Plan [3].

1.3 REFERENCES

1. Document 033-600004, Demand Access System (DAS) System/Subsystem Specification, Revision A, 21 February 2001.
2. Document 024-600007, Demand Access System (DAS) Performance Verification Matrix (PVM), Revision C, 20 June 2002.
3. Document 009-600085, Acceptance Test Plan and Procedures for the Demand Access System (DAS), Volume I: Verification Plan, Revision B, 17 October 2001.
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5. TGBFS Algorithmic Description Document, 033-140769, 3 January 1999.
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10. Omura, J, and Kalaith,T., "Some Useful Probability Distributions," Technical Report 7050-6, Office of Naval Research, September 1965.
11. "CRC Standard Mathematical Tables," 14th Edition, June 1965.
12. "DAS Reliability/Maintainability/Availability (RMA) Analysis Report," 035-600010, Rev A, ITT Industries, 21 February 2001.
13. Document 033-140767, "Specification for the Third Generation Beamforming Subsystem," Revision -, 25 February 1999.
14. Data Sheet for the IBUG Model 5123, ITT Industries, BR00004.DOC.
15. "Software Design Document for the DMG," ITT Industries, TR01072, Rev -, 1 October 2001.
16. TM 01-009, AVTEC User's Guide, Supplemental Module Documentation, Version 1.50, Draft, 8 June 2001.

17. TM 01-TBD, AVTEC User's Guide, Version 1.50, Draft, 30 January 2001.
18. TM 01-012, DAS System Test Procedures for the AVTEC PTP, Draft, 27 June 2001.
19. DAS Critical Design Review, 22-23 February 2001.
20. The TDRSS Demand Access System (DAS) Trade Study, "Switching and Scheduling Approaches," ITT Report, 16 June 2000.
21. TGBFS Critical Design Review, 30 January 1998.
22. Training Plan: Demand Access System (DAS) Training Plan; System Level and Level 2 Training; 028-600153, Revision C, May 13, 2002.
23. Training Materials: Demand Access System (DAS) Basic Operations and Level 1 Maintenance Course; 032-600175, Draft, 22 July 2002.
24. Training Materials: Demand Access System (DAS) Demodulator Group (DMG) Level 2 Maintenance; 032-600176, 1st Draft, undated. (To be released)
25. Training Materials: Demand Access System (DAS) Level 2 Software Maintenance; 032-600177, First Draft, undated. (To be released)
26. DAS O&M Manual: Operation and Maintenance Manual for the Demand Access System (DAS); Second Draft, 015-600012, Revision B, 20 June 2002.
27. Revision to IBUG Manual: Operation and Maintenance Manual for the Independent Beamforming Unit Group (IBUG) and the IBUG Controller; 015-146722, Revision undated (to be released).
28. Revision to EMC/ECON: Operation and Maintenance Manual for the Element Multiplexer/Correlator (EMC) and the EMC Controller; 015-140893, Revision E undated (to be released).
29. DMG Manual: Maintenance Manual, Level 2, Demodulator Group Hardware and Firmware; 015-600161, undated (to be released).
30. FO Switch: Maintenance Manual, Level 2, Fiber Optic Switch Control Processor Software; 015-600162, undated (to be released).
31. DASCON: Maintenance Manual, Level 2, Demand Access System Controller (DASCON) Software; 015-600163, undated (to be released).
32. DCON: Maintenance Manual, Level 2, Demodulator Group Controller (DCON) Software; 015-600164, undated (to be released).
33. PN/Carrier Acquisition Algorithm Description Document Revision -, undated (to be released).

1.4 DOCUMENT ORGANIZATION

The remaining portion of this document is organized as follows:

- Section 2 presents results for all analysis verification cases
- Section 3 presents results for all inspection verification cases
- Section 4 provides a list of all analysis and inspection verification discrepancies, and a list of those requirements whose verification is pending SAT
- Appendix A includes all Waivers that have been approved and are relevant to the DAS Analysis and/or Inspection Cases
- A list of abbreviations and acronyms is provided at the end of the document.

2. ANALYSIS CASES

2.1 OVERVIEW

As approved by the NASA DAS Product Manager, the analysis verification method is defined as:

Analysis is the method used to verify that an item conforms to the specified requirements by performing and evaluating calculations, computations, modeling, simulation, analytical solutions, studies, and reduced or representative data. In performing analysis, verification personnel shall: 1) Study and examine engineering drawings, software and hardware flow diagrams, and specifications; 2) Perform modeling and simulation and assess the results; or 3) Perform a combination of activities 1) and 2) above.

2.1.1 Summary

DAS verification is divided into a series of analysis, inspection, and test cases, each of which is designed to verify one or more DAS System requirements. Section 2 addresses the DAS analysis cases, as identified in the DAS Verification Plan [3] and summarized in Table 2.1-1. Note that Column 4 of the table summarizes the results of the analyses for each case. Each of these cases is detailed individually in the subsections that follow. As indicated in Column 4, all requirements have been verified successfully.

Table 2.1-1: Summary of DAS Analysis Cases

1	2	3	4	5	6
Analysis Case #	**Analysis Case Title**	**Number of SRD Requirements to be Verified**	**# Reqmts that failed**	**# Reqmts requiring completion of SAT**	**A&I Report Section**
A1	Modular Expandability	2	0	0	2.2
A2	Deleted	0	0	0	2.3
A3	RFI and Signal Distortions	17	0	0	2.4
A4	Bit Slip	3	0	0	2.5
A5	False Acquisition and Reacquisition	3	0	0	2.6
A6	Return Data Handling	3	0	0	2.7
A7	RMA	9	0	0	2.8
A8	Training	8	0	0	2.9
A9	Maintenance	13	0 (5 pending Level 2 doc)	0	2.10
	Total =	58	0	0	

2.1.2 Receiver Description and Design

As will be seen, many of the analyses below depend upon receiver design and associated signal processing algorithms. Accordingly, this subsection provides important insight into these considerations.

2.1.2.1 Receiver States Overview

Figure 2.1-1 describes the receiver states.

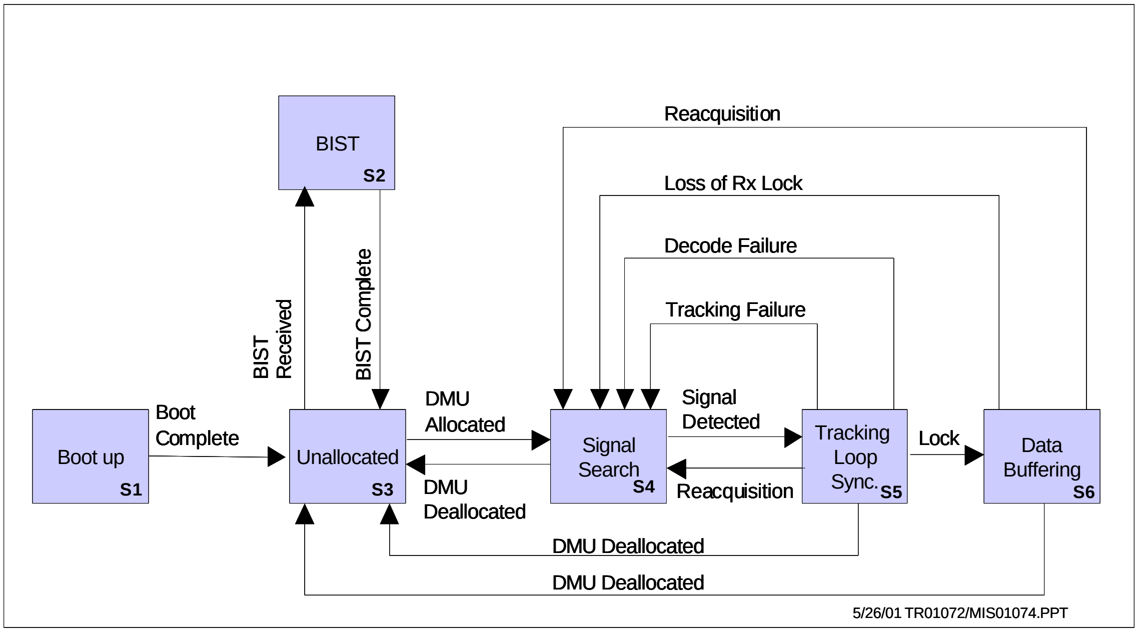

Figure 2.1-1: Describes The Receiver States.

As shown, after the receiver has been allocated to a user service, it automatically begins a search for a signal in state S4, shown in Figure 2.1-1. In this state, the receiver is performing a PN Code search using threshold detection to determine if a valid signal is present. If the threshold is exceeded, the receiver performs a series of Carrier and PN Code acquisitions coupled with False Acquisition (FA) testing. If all FA tests pass, the receiver declares a ‘signal detect’ and proceeds to tracking in state S5. This successful acquisition occurs within a few seconds once a valid signal is present, as discussed in additional detail below. If the FA tests fail, the receiver reverts back to the initial search process in state S4, continuously looking for PN code correlations that cross the threshold until the receiver is either de-allocated or a valid signal appears.

After carrier acquisition, the receiver (still in state S5) attempts to close its tracking loops in order to achieve fine tracking. A lock detector indicates when fine tracking has been accomplished. While this is being performed, the on-chip (i.e., Viterbi Decoder chip) Node Sync Detection circuitry is also testing for decoder node sync. Node sync is resolving which symbol is the G1 code symbol and which is the G2 code symbol. The receiver then looks for lock indications from the tracking loops and the Viterbi Decoder. If both lock indications are successful within a specified “time out” condition (i.e., 6,000 symbols for bi-phase format, 13,000 for NRZ format), the DMU enters state S6 and data is processed, buffered and sent to the DAS PTPs. On the other hand, if one or both lock indications fail at the end of the time-out interval, then the receiver never transitions to State S6, but instead returns to search mode in state S4. For high data rates, this time-out interval becomes exceedingly small, so that a lower limit of 50 msecs is used per Waiver DAS-D02 (Appendix A.1).

This Decoder Node Sync algorithm is depicted in Figure 2.1-2, in which the symbol sequence length for decision-making and the number of errors within this length are selectable parameters. For DAS, a 1000 symbol sequence length with fewer than 400 errors has been selected to ensure that the probability of declaring a valid node sync state as invalid is essentially zero. Note that the Viterbi Decoder chip is conducting this node sync operation at the same time the tracking loops are closing.

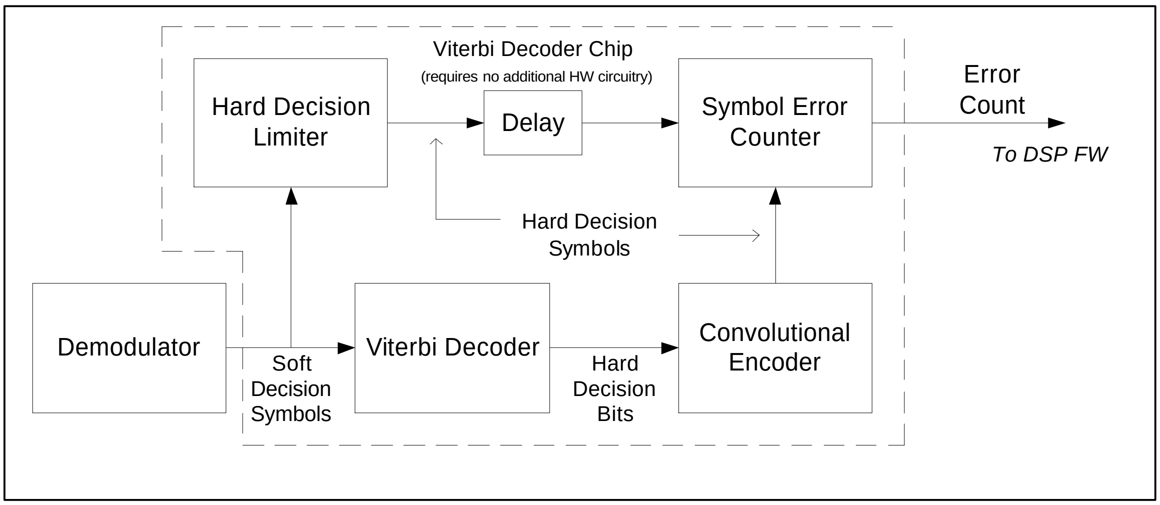

Figure 2.1-2: Viterbi Decoder Fault Detection

While in state S6, the receiver monitors the receiver lock detector (i.e., tracking loop performance) and Viterbi decoder Node Sync. Whenever there is a loss-of-lock, the receiver returns to state S4 and performs a mini acquisition (termed ‘reacquisition’) using its best known frequency and PN Code phase values prior to the loss-of-lock. If PN code acquisition is successful here, carrier acquisition is performed, and the receiver will move into state S5, in which it attempts to transition back to fine tracking. If reacquisition fails, it reverts back to the initial acquisition mode or search mode, also in state S4.

2.1.2.2 Acquisition Overview

The acquisition strategy is described in the DMG PN/Carrier Acquisition Algorithm Description Document [33].

2.1.2.3 Tracking Loop Design Parameters

Table 2.1-2 summarizes the tracking loop bandwidths (B_L) and the corresponding ‘$B_L T$ product’, where T = the bit duration = 1/data rate = $1/R_d$.

Table 2.1-2: DAS DMU Tracking Loop Bandwidths

Data Rate	PN Tracking Loop			Carrier Tracking Loop			Symbol Tracking Loop		
(Kbps)	B_L (Hz)	Loop Update (μs)	B_LT Product (no units)	B_L (Hz)	Loop Update (μs)	B_LT Product (no units)	B_L (Hz)	Loop Update (μs)	B_LT Product (no units)
1	5	2000	0.01	20	500	0.010	10	1000.0	0.010
2	5	2000	0.01	40	250	0.010	20	500.0	0.010
3	5	2000	0.01	60	200	0.012	30	333.3	0.010
4	5	2000	0.01	80	200	0.016	40	250.0	0.010
5	5	2000	0.01	100	200	0.020	50	200.0	0.010
10	5	2000	0.01	200	200	0.040	100	100.0	0.010
15	5	2000	0.01	250	200	0.050	150	100.0	0.015
20	5	2000	0.01	250	200	0.050	200	100.0	0.020
25	5	2000	0.01	250	200	0.050	250	100.0	0.025
30	5	2000	0.01	250	200	0.050	300	100.0	0.030
35	5	2000	0.01	250	200	0.050	350	100.0	0.035
40	5	2000	0.01	250	200	0.050	400	100.0	0.040
45	5	2000	0.01	250	200	0.050	450	100.0	0.045
50	5	2000	0.01	250	200	0.050	500	100.0	0.050
60	5	2000	0.01	250	200	0.050	500	100.0	0.050
70	5	2000	0.01	250	200	0.050	500	100.0	0.050
80	5	2000	0.01	250	200	0.050	500	100.0	0.050
90	5	2000	0.01	250	200	0.050	500	100.0	0.050
100	5	2000	0.01	250	200	0.050	500	100.0	0.050
110	5	2000	0.01	250	200	0.050	500	100.0	0.050
120	5	2000	0.01	250	200	0.050	500	100.0	0.050
130	5	2000	0.01	250	200	0.050	500	100.0	0.050
140	5	2000	0.01	250	200	0.050	500	100.0	0.050
150	5	2000	0.01	250	200	0.050	500	100.0	0.050

2.2 ANALYSIS CASE 1: MODULAR EXPANDABILITY

2.2.1 Summary (2 Requirements)

The objective of Analysis Case 1 is to verify requirements related to DAS Modular Expandability. Specific requirements to be verified are listed in Table 2.2-1. Columns 1-5 of the table are extracted directly from the DAS Verification Planning Table (Appendix C of the DAS Verification Plan [3]). As indicated in Column 7, all requirements have been successfully verified.

Q4.4 verified that IBUGs and DMGs could be added to the initial implementation that is being deployed. A1 verifies that the DAS design is expandable beyond the initial capability (i.e., > 10 IBUGs and 8 DMGs). Note that an ITT Trade Study [20] previously examined potential approaches to switching and connecting both EMCs-to-IBUs (via the FO Switch) and IBUs-to-DMUs (via the IF Switch) in the context of expansion.

Table 2.2-1-1: Analysis Summary for Analysis Case 1 (Modular Expandability)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
144	3.1.9.a	The DAS implementation shall provide for modular expandability of beamformers.	Q4.4 will verify that IBUGs can be added to the initial implementation that is being deployed. The DAS architecture and design documentation will be assessed	The analysis must how the design would be changed to accommodate future expansion of IBUGs (>10) and IBUs (>60). These design changes must be viable without undue design and cost impacts. .	The initial Full-up DAS Operating Capability consists of a maximum of 60 IBUs at each GT The approach to expandability is different at GRGT vs WSGT <u>GRGT</u> The initial Full-up DAS Operating Capability at GRGT does not have any FO switching capability Each IBUG must have its own set of 5 fibers from the EMC Because of the constraint in the max number of fiber sets that an EMC can provide (max of 11), even going beyond a few IBUGs is problematic without a FO Switch (for 'fan-out' rather than switching) Growth at GRGT therefore requires the addition of a FO Switch One straightforward growth path would be to have multiple FO Switches, where each consists of two Systran NTSs and each would be connected to a different set of EMC Fibers – this would provide 60 IBUs to each FO Switch in the same manner as is done today in the DAS WSGT configuration Other possible configurations were discussed as part of the TGBFS CDR [21, page 2-3 to 2-9] and in [20]. <u>WSGT</u> The initial Full-up DAS Operating Capability at WSGT has a FO Switch (consisting of 2 Systran NTS) to provide EMC outputs to up to 60 IBUs One straightforward growth path would be have multiple FO Switches, where each consists of two Systran NTSs and each would be connected to a different set of EMC Fibers – this would provide 60 IBUs to each FO Switch in the same manner as is done today in the DAS WSGT configuration Other possible configurations were discussed as part of the TGBFS CDR [21, page 2-3 to 2-9] and in [20] For both GRGT and WSGT growth, the DASCON and ICON SW would require modifications to be able to control and status the new FO Switch(es)	Pass
145	3.1.9.b	The DAS implementation shall provide for modular expandability of demodulators	Q4.4 will verify that DMGs can be added to the initial implementation that is being deployed. The DAS architecture and design documentation will be assessed	The analysis must how the design would be changed to accommodate future expansion of DMGs (> 8) and DMUs (>64). These design changes must be viable without undue design and cost impacts.	The initial Full-up DAS Operating Capability consists of 64 DMUs at each GT, and is based on a single IF Switch at each GT. The Universal Switching Corp. IF Switch that is being used has 8 port cards, each card having 8 input and 8 output ports, yielding a maximum of 64 outputs Since an IBU must be able to be connected to only up to 16 pre-assigned DMUs, it is straightforward to connect a subset of IBUs	Pass

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Analysis Findings	Pass or Fail
					through one IF Switch and another subset of IBUs through another IF Switch to other DMUs, thereby readily expanding to > 64 DMUs This is achievable since there is no requirement that an IBU be able to connect to all DMUs (just a max of 16) Examples of various possible approaches for expansion are presented in Reference [20] The DASCON and DCON SW would require modifications to be able to control and status the new IF Switch (es)	

2.3 ANALYSIS CASE 2: DELETED

2.4 ANALYSIS CASE 3: RFI AND SIGNAL DISTORTIONS

2.4.1 Summary (17 Requirements)

The objective of Analysis Case 3 is to verify requirements related to the impact of RFI and various signal distortions. Specific requirements to be verified are listed in Table 2.4-1. Ensuing subsections of Section 2.4 provide additional detail as backup to the summary in Table 2.4-1. As indicated in Column 7, all requirements have been successfully verified.

Table 2.4-1: Analysis Summary for Case 3 (RFI and Signal Distortions)

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Analysis Findings	Pass or Fail
198	3.2.4.2.1.2.a	The DAS equipment shall not be damaged or cumulatively degraded by the input signal.	Because the input to the DAS is digital, the only concern here is whether the IBU can output an analog signal that exceeds the input capabilities of the IF Switch and DMU analog front.	The analysis must show that the DMU can accommodate the maximum signal input from the IBU plus any additional IF Switch signal amplification.	(See Section 2.4.2 for additional details) Maximum IBU output power is + 6 dBm under maximum RFI IF Switch can handle +25 dBm input DMU can handle +21 dBm input Thus, DAS can accommodate the maximum RFI input without damage	Pass
199	3.2.4.2.1.2.b	The DAS shall not extend the effect of each pulse by more than 100 ns.	The focus here is on the processing in the latter stages of the IBU processing (limiting and D/A conversion) and the front-end of the DMU A/D conversion.	The analysis must show that the processing in the IBU and DMU is such that the pulse width is not extended more than 100 ns.	Max RFI pulse width is 5 μsec (SRD 3.2.4.2.1.2; thus, 100 ns requirement corresponds to 2% of the max pulse duration The recovery time of the TDRS limiter is ~ 1-2 μsecs [4, p.42] so this is the major contributor to RFI Pulse extension time The TGBFS IBUs use the same arithmetic algorithms [5] as used in the STGT AGIPA beamformers As noted in [4; p.65], “there is no pulse extension” created by the beamformers in response to an RFI pulse	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
					The DMU front-end elements (see Section 2.4.2) that may affect pulse duration are the analog filter and the Variable Gain Amplifier (Part# AD603) The specs on the VGA indicate a group delay of 2 nsec, which means that any energy dispersal will be substantially less than the 100 μsec requirement. Thus, DAS does not extend a RFI pulse by more than 100 nsecs	
200	3.2.4.2.1.2.c	The DAS shall provide for the operation of all signal processing functions, from EMC output to baseband, in the presence of pulsed RFI	The dynamic range of the IBU has already been assessed under the TGBFS program for pulsed RFI; the focus is on the IF switch and the demod.	The analysis must show that the dynamic range of IF Switch accommodates the pulsed RFI effects from the IBU output; Must show that the DMU can function with RFI pulses of ≤ 5 μsec by looking at the analog /digital AGC function.	(See Section 2.4.2 below for additional details) Nominal IBU output power is -4 dBm, and +6 dBm under the maximum RFI power increase of 10 dB due to the onboard TDRS clipper The dynamic range of the IF Switch is [–20 dBm, +3 dBm] which means that additional RFI suppression occurs due to the IF Switch saturation for signals > 3 dBm - which actually enhances performance The DMU operates with an upper dynamic range to at least +21 dBm (Section 2.4.2) Thus, DAS supports signal processing operations in the presence of pulsed RFI	Pass
226	3.2.4.2.1.6.o	The specified performance shall be achieved when the signals at the LNA input contain the signal characteristics of Paragraph 3.2.4.2.1.2.	The signal characteristics of Paragraph 3.2.4.2.1.2 relate to the additional user dynamics that will not be tested under Paragraph 3.2.4.2.1.6.n (White Gaussian Noise only). Standard formulations will be used to calculate the additional losses due to dynamics. The demo will show the losses under ideal signal conditions with Gaussian noise only. Additional losses due to beamforming will also be included here including ephemeris errors. The loss budget was provided at PDR and will be reassessed and documented in the A&I report.	The analysis must show that for a 2nd order tracking loop, the additional losses due to the signal dynamics can be accommodated in the loss budget within the test results of Paragraph 3.2.4.2.1.6.n. (note: This analysis augments testing in Q3 for 3.2.4.2.1.6)	(See Section 2.4.3 for additional details) The two signal characteristics of concern here in the SRD are: (1) user spacecraft dynamics and (2) phase noise Spacecraft Dynamics causes < 0.2° error in the tracking loops which has negligible impact Phase noise, under worst case assumptions induces less than 1°of error These additional phase errors effects are significantly less than the effects due to thermal noise for which detailed testing (Q3) will be performed Thus, DAS performance will essentially be driven by thermal noise and not by the signal conditions of SRD Paragraph 3.2.4.2.1.2.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
241	3.2.4.2.1.13.a	The DAS shall accommodate an input C/No variation of 12 dB, at a rate not to exceed 10 dB/sec, without requiring a reconfiguration	The analysis focuses on the rate of variation. Since the signal is noise dominated the only impact of concern is on the DMU; the analysis will examine the relevant design elements of the DMU: the noncoherent AGC, the coherent AGC and the tracking loop bandwidths.	The analysis must show that the rate of variation does not adversely affect the operation of the AGCs and that the loop bandwidths are sufficiently high so that they can accommodate the specified rates.	The DMU noncoherent AGC acts on signal within the entire 6 MHz MA bandwidth; hence it is noise-driven and independent of signal C/No variations The coherent AGC is used to maintain a constant signal into the tracking loops which would affect the effective loop bandwidth if it were to vary The "coherent AGC" is achieved by normalizing the tracking loop discriminators with an average of I-channel soft decision symbol absolute values. The number of symbols used to compute the average can range from 240 to 480. Worst case update rate is at 1 kbps; here, the symbol rate is 2000 symbols per second. The DMU updates every 240 symbols, which is 240/2000 = 120 ms. The time interval between normalization factor decreases to 5 ms intervals for data rates beyond 48 kbps. The max C/No variation rate of 10 dB/sec translates into about 1 dB change each 100 msec The worst case 120 ms update rate is sufficient to capture most of the change in the averaging process noted above These small errors in the normalization factor result in corresponding small changes in the loop bandwidth (B_L). This in turn has a small and transient impact on receiver performance because phase error varies with the square root of B_L, and the subsequent SNR loss varies as the $\cos^2$ of the phase error For example @ 1 dB error in B_L, the phase error increases by a factor of 1.12. Even at 10° phase error for BPSK, this translates into less than 0.1 dB SNR loss Thus, DAS accommodates a 10 dB/sec C/No variation	Pass
242	3.2.4.2.1.14.a	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: Data asymmetry $\leq \pm 3\%$	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	The SRD requirement does not attach a specific implementation loss requirement for this input signal distortion; the SRD rather just requires that the system still works – years of analysis and simulation have previously characterized the impact of these distortions and have shown that the receiver design is unaffected except that a small implementation loss results In 1998, ITT conducted an assessment	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
			performance.		of these distortions for NASA/GSFC Code 450 using the SPW (Signal Processing Workstation) simulation tool Results of this effort were documented in a memo [6]. The results indicated that the cumulative impact of the distortions in SRD 3.2.4.2.1.14.a – 3.2.4.2.1.14.l causes small implementation loss but does not affect the signal processing operation Thus, DAS provides for operation of all signal processing functions from EMC output to baseband with an input signal containing the distortions in Paragraph 3.2.4.2.1.14.a to l.	
243	3.2.4.2.1.14.b	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: Data transition time ≤ 5% of bit time but no less than 35 nsec	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
244	3.2.4.2.1.14.c	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: I/Q data skew (relative to requirements for I/Q data synchronization) ≤ 3%	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
245	3.2.4.2.1.14.d	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: I/Q PN chip skew (relative to 0.50 chip) ≤ 0.01 chip	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Analysis Findings	Pass or Fail
246	3.2.4.2.1.14.e	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: PN code power suppression < 0.3 dB	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
247	3.2.4.2.1.14.f	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: PN chip rate (relative to absolute coherence with carrier rate) ≤ 0.01 Hz at PN rate	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
248	3.2.4.2.1.14.g	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: BPSK phase imbalance ≤ ± 3°	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
249	3.2.4.2.1.14.h	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: Gain imbalance ≤ ± 0.25 dB	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
250	3.2.4.2.1.14.I	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
		input signal containing the following additional distortion: QPSK phase imbalance 90 ± 3°	tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.			
251	3.2.4.2.1.14.j	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: AM/PM $\leq$ 12°/dB	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
252	3.2.4.2.1.14.k	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: Spurious PM (100 Hz to 3 MHz) $\leq$ 3° rms	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass
253	3.2.4.2.1.14.L	The DAS shall provide for operation of all signal processing functions from EMC output to baseband with an input signal containing the following additional distortion: Incidental AM (3σ) (at frequencies > 10 Hz for data rates < 1 kbps; at frequencies > 100 Hz for data rates $\geq$ 1 kbps) $\leq$ 6%	The signal is buried in noise so that these distortions can only affect the DMU. Use CLASS simulation results to assess DMU tracking performance. Use the noise-dominated signal aspect and the specific acquisition algorithms to assess DMU acquisition performance.	The analysis must show that the DMU can still acquisitionuire and track in the presence of these signal distortions.	See SRD Req # 242 above	Pass

2.4.2 Additional Analysis Details for SRD Reqs #198-200 (Dynamic Range)

TGBFS design analysis and test results [14] have shown linear operation from the input to the ADQS to the output of the TGBFS IBU, as illustrated in Figure 2.4-. For the nominal theoretical element input power of S_{in} = –36 dBm [4], the IBU outputs a formed beam signal of S_{out} = –4 dBm. No AGC operation is performed by any of the processing components shown in Figure 2.4-1, and S_{out} = S_{in} +32 dBm. RFI signals are limited by a 10-dB clipper onboard TDRS. Consequently, the maximum IBU output is +6 dBm in the presence of RFI.

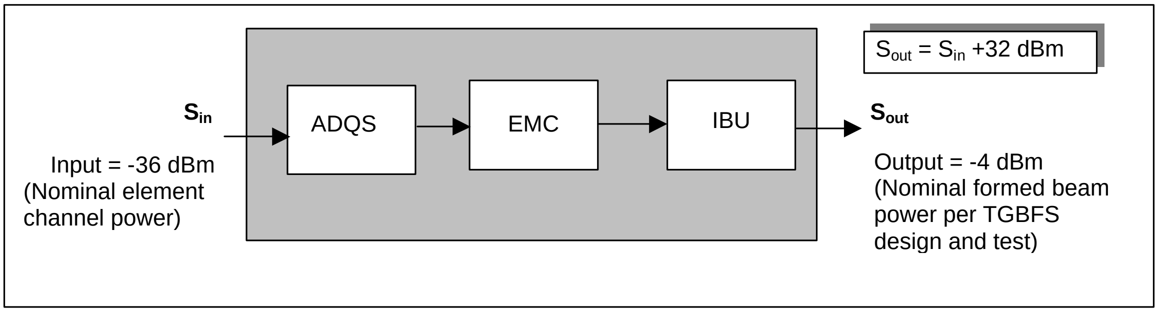

Figure 2.4-1: Nominal Input/Output Signal Powers

The S6400A IF Switch specification indicates that the maximum input level (without damage) is ± 5v at 75 ohm input impedance. This corresponds to an input power of ~ 25 dBm, which is well above the required 6 dBm value. The IF Switch has a nominal input dynamic range of [–20 dBm, +3 dBm] over which it is essentially linear (±1 dB over 50 MHz). Above +3 dBm, the amplifiers begin to saturate and are no longer linear. This implies that the maximum input to the DMUs is bounded by + 6 dBm under RFI conditions.

The ACM (Analog Conversion Module) of the DMU receives the output from the IF Switch and digitizes it for digital processing by the DMU DPM (Digital Processing Module). The DMU's analog front end follows this path:

- Connector
- Limiting Diodes [Part# 1N4148WS]
- Filter (20 MHz cutoff frequency Chebyshev, 7 pole analog filter)
- Attenuator
- Variable Gain Amp (VGA) [Part# AD603].

The maximum input to the VGA (without damage) is +16 dBm and the attenuator provides 23 dB of attenuation so the maximum input at the connector (assuming no loss in the filter) is +39 dBm. At that point, however, the limiting diodes would take effect, which as discussed below are the limiting devices on the DMU input. There are two series diodes to ground oriented in a back-to-back fashion to shunt the signal to signal return (the coax ground). The diodes (Diode Inc. 1N4148WS-7s) are each rated at 200 mW dissipation. Their forward voltage (@ 50 mA) is 1 volt. This means that up to 0.715 V each (about a diode drop and the specified 1 mA current draw voltage), the diodes do not appreciably affect the signal. Above about 2.8 V (peak-to-peak), the diodes start to draw power. All the remaining devices on the ACM can easily tolerate this level of input voltage because there is a 20 dB attenuator prior to the variable gain amplifier.

Working with these numbers we have:

(2.8V/2) * 1/(sqrt(2)) = 1 V rms into 50 ohms, this is (V^2)/R = 1/50 = 20 mW = + 13 dBm without distortion.

The absolute power in is larger, and can be derived from as follows:

150 mA @ 1.25V (from the diode curve) would provide a peak-to-peak voltage of 5V which yields +18 dBm. Note that this is a single sided power (diodes on one side will cool while the ac input cycles around 0V ac) and that the device would be able to withstand +21 dBm without damage.

2.4.3 Additional Analysis Details for SRD Req #226 (Phase Noise and S/C Dynamics)

The signal conditions referred to here from SRD Paragraph 3.2.4.2.1.2:

- Frequency and PN chip rate signal dynamics will result from Customer spacecraft dynamics:

  $\dot{R}$ (Velocity) < 12 km/sec

  $\ddot{R}$ (Acceleration) < 15 m/sec^2

  $\dddot{R}$ (Jerk) < 0.02 m/sec^3.

- The Phase Noise of the received DAS signal is:

  1 Hz to 1 kHz < 2.7° rms

  1 kHz to 3 MHz < 2.0° rms.

Since DMU testing will include only White Gaussian Noise, these effects must be considered separately and ultimately be accounted for in the DAS implementation loss budget. The DAS demods employ 2nd order tracking loops for PN and carrier tracking. Accordingly, Doppler is tracked out but any Doppler Rate (D_R) components produce a residual error given by:

$$\theta_e = [(180/\pi) \times 1.77 \times D_R]/B_L^2 \text{ ; } B_L = \text{Loop Bandwidth, } D_R \text{ is in Hz/sec}$$

Since the DMU performs Doppler Correction, the residual Doppler Rate component comes from the ± 9 secs ephemeris uncertainty that produces the following at 2.2875 GHz return frequency:

$$D_R = [9 \text{ secs} \times 0.02 \text{ m/sec}^3] \times [2.2875/0.3 \text{ Hz/(m/sec)}]$$

$$= 1.4 \text{ Hz/sec}$$

For all data rates, the Carrier Loop B_L >20 Hz (Table 2.1-2), so that the error is bounded by

$$\theta_e < 0.2°$$

The initial Doppler offset for acquisition due to theses user dynamics depends on the user acceleration term (15 m/sec^2) along with the ± 9 secs ephemeris uncertainty:

$\Delta F =$ [9 secs x 15 m/sec^2] x [2.2875/0.3 Hz/(m/sec)]

$=$ 1030 Hz.

This frequency error has been accounted for in the DMU acquisition testing that occurs in Qual Test Q3 [3].

The phase noise affects carrier tracking only to the extent of the portion that is untracked, i.e., the phase noise energy that is outside the tracking loop bandwidth. Worst case is bounded by the rms sum of the phase noise components:

$$\sigma_p = \text{sqrt}\,[2.72° + 2.02°] = 3.36°.$$

This is the worst-case phase error due to phase noise because it assumes that no phase noise is being tracked. Even for the lowest data rate, the BL is 20 Hz and thus would substantially reduce the 2.72° component. This induced phase error must be 'rms-ed' with the phase error due to thermal noise (i.e., the error essentially manifested in testing).

Phase error (σn) due to thermal noise depends upon the loop BLT product, which is ≤ 0.05 (Table 2.1-2). For a second order loop, the phase error variance is given by:

$$\begin{aligned} \sigma_n^2 &= B_L T/[Eb/No] \qquad \text{(radians}^2\text{)} \\ &\leq 0.05/[Eb/No] \\ &\sim 0.05/[4.4]_{dB} \\ &\sim 0.018 \text{ radians}^2. \end{aligned}$$

Accordingly,

$$\sigma_n \sim 7.7° \text{ (rms)}.$$

The total phase error (σT) is then given by:

$$\begin{aligned} \sigma_T &= \text{sqrt}\,[\sigma_n^2 + \sigma_p^2] \\ &\sim 8.4° \text{ (rms)}. \end{aligned}$$

RMS Phase error (σT) reduces the effective SNR according by the factor '[cos2(σT)]'. For the phase errors noted above, it can be readily shown that the additional SNR loss due to phase noise ~ 0.015 dB, and thus has negligible impact of the DAS carrier tracking loops.

2.5 ANALYSIS CASE 4: BIT SLIP

2.5.1 Summary (3 Requirements)

The objective of Analysis Case 4 is to verify requirements related to bit slip performance. Specific requirements to be verified are listed in Table 2.5-1. Ensuing subsections of Section 2.5 provide additional detail as backup to the summary in the table. As indicated in Column 7, all requirements have been successfully verified.

Table 2.5-1: Analysis Summary for Case 4 (Bit Slip)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
235	3.2.4.2.1.9.a	Normal Transition Density: The mean time between slips caused by a cycle slip in the symbol clock recovery loop shall be either no less than 90 minutes or no less than 10^{10} clock cycles, whichever is greater, for the C/N_O required for 10^{-5} P_E performance. This requirement applies for transition densities of at least 40% for NRZ symbols and any transition density for biphase symbols.	Use standard formulations for 'time to cycle slip' in a 2nd order loop based on loop bandwidths projected for DAS. Use an effective 'reduced data rate' to account for the data transition rate in NRZ performance analysis.	The analysis must show that the mean time to cycle slip exceeds the required value.	(See Section 2.5.2 for additional details) For Bi-phase data and any transition density, the mean time to cycle slip with an Eb/No =4.5 dB is >10^{246} clock cycles > 10^{10} clock cycles > 90 minutes For NRZ data and the normal transition density of 40%, the mean time to cycle slip with an Eb/No =4.5 dB is >10^{99} clock cycles > 10^{10} clock cycles > 90 minutes Thus, DAS achieves the required mean time to bit slip time.	Pass
236	3.2.4.2.1.9.b	Low Transition Density. The mean time between slips caused by a cycle slip in the symbol clock recovery loop shall be either no less than 90 minutes or no less than 10^{10} clock cycles, whichever is greater, for 1.0 dB more C/N_O than required for 10^{-5} P_E performance. This requirement applies for NRZ symbol transition densities between 25% and 40%.	Use standard formulations for 'time to cycle slip' in a 2nd order loop based on loop bandwidths projected for DAS. Use an effective 'reduced data rate' to account for the data transition rate in NRZ performance analysis.	The analysis must show that the mean time to cycle slip exceeds the required value.	(See Section 2.5.2 for additional details) For NRZ data and the low transition density of 25%, the mean time to cycle slip with an Eb/No =5.5 dB is >10^{78} clock cycles > 10^{10} clock cycles > 90 minutes Thus, DAS achieves the required mean time to bit slip time.	Pass
237	3.2.4.2.1.10.a	The mean time-to-cycle slip in tracking the carrier shall be greater than or equal to 90 minutes for a 3 dB less C/No than required for 10^{-5} P_E performance	Use standard formulations for 'time to cycle slip' in a 2nd order loop based on loop bandwidths projected for DAS.	The analysis must show that the mean time to cycle slip exceeds the required value even under a 3 dB fade.	(See Section 2.5.2 for additional details) For NRZ data and the low transition density of 25%, the mean time to cycle slip with an Eb/No =1.5 dB is >10^{31} clock cycles > 10^{10} clock cycles > 90 minutes Thus, DAS achieves the required mean time to bit slip time.	Pass

2.5.2 Additional Analysis Details for SRD Req #235-237 (Bit Slippage)

With reference SRD Paragraph 3.2.4.2.1.9, the SRD requires that the mean time to cycle slip be greater than the larger of 90 minutes or 10^{10} clock cycles. Table 2.5-2 shows that for the data rates of concern, 10^{10} clock cycles is always greater than 90 minutes and thus 10^{10} clock cycles is the driver for the SRD Req #236-237.

Table 2.5-2: Time for 10^{10} Clock Cycles

Data Rate (kbps)	Clock duration secs	Time for 10^{10} clock cycles secs	mins
1	1.00E-03	10,000,000	166,667
10	1.00E-04	1,000,000	16,667
50	2.00E-05	200,000	3,333
100	1.00E-05	100,000	1,667
150	6.67E-06	66,667	1,111

For the DAS second order bit-synch tracking loop, it can be shown [7, p.383] that the mean Time to Cycle Slip (Tcs) is:

$$T_{cs} \sim (\pi/4B_L)\, e^{2\alpha} \quad ;$$

Where α = loop SNR given by:

$$\alpha = [Eb/No]/[B_L T].$$

Consequently:

$$T_{cs} \sim (\pi/4B_L)\, e^{2\{[Eb/No]/[B_L T]\}}$$

$$= T\,(\pi/4B_L T)\, e^{2\{[Eb/No]/[B_L T]\}}$$

Accordingly, the largest BLT product over all data rates provides the smallest T_{cs}. With reference to Table 2.1-1, we note that the largest Symbol Tracking BLT is 0.01 and corresponds to 1 kbps:

$$T_{cs} > T\,(\pi/4[(0.01])\, e^{2\{[4.5\text{ dB}]/[0.01]\}}$$
$$\sim T\,(5\text{x}10^{246})$$
$$> T\,10^{10} \quad ; \qquad \text{(Biphase Symbol format).}$$

The DAS employs a Decision Directed Tracking Loop (DTTL) for the bit synchronizer so that the discriminator is only computed when a transition is detected in the recovered symbol stream. For Biphase data, this means that there is always a transition for every symbol, but this is not the case for NRZ symbols where data bit transition density affects the decision making process. As a bound on T_{cs}, we can increase the "T" in the BLT product by the normal transition density, which for SRD Paragraph 3.2.4.2.1.9.a is 40%. This means that the largest effective BLT is 0.025 (= 0.01/0.4), which yields:

$$T_{cs} > T\,(\pi/4[(0.025])\, e^{2\{[4.5\text{ dB}]/[0.025]\}}$$

$$\sim \quad T\,(2.6\mathrm{x}10^{99})$$
$$> \quad T\,10^{10} \;; \qquad \text{(NRZ Symbol format; normal Transition Density).}$$

The low transition density of SRD Paragraph 3.2.4.2.1.9.b is reduced to 25%. This means that the largest effective BLT is 0.04 (= 0.01/0.25). In addition, the C/No or Eb/No is increased by 1 dB, which yields:

$$T_{cs} \quad > \quad T\,(\pi/4[(0.04])\; e^{2\{[5.5\ \mathrm{dB}]/[0.04]\}}$$
$$\sim \quad T\,(2.2\ \mathrm{x}10^{78})$$
$$> \quad T\,10^{10} \;; \qquad \text{(NRZ Symbol format; low Transition Density).}$$

SRD Paragraph 3.2.4.2.1.10.a requires the specified bit sync performance with 3 dB less C/No. Using Eb/No =1.5 dB (vs 4.5 dB) and the worst transition Density (=25%) gives:

$$T_{cs} \quad > \quad T\,(\pi/4[(0.04])\; e^{2\{[1.5\ \mathrm{dB}]/[0.04]\}}$$
$$\sim \quad T\,(9.2\ \mathrm{x}\ 10^{31})$$
$$> \quad T\,10^{10} \;; \qquad \text{(NRZ Symbol format; low Transition Density).}$$

2.6 ANALYSIS CASE 5: FALSE ACQUISITION AND REACQUISITION

2.6.1 Summary (3 Requirements)

The objective of Analysis Case 5 is to verify requirements related to false acquisition and automatic reacquisition. Specific requirements to be verified are listed in Table 2.6-1. Ensuing subsections of Section 2.6 provide additional detail as backup to the summary in Table 2.6-1. As indicated in Column 7, all requirements have been successfully verified.

Table 2.6-1: Analysis Summary for Case 5 (False Acquisition and Reacquisition)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
238	3.2.4.2.1.11.a	During signal acquisition and signal tracking, DAS services shall be protected against false carrier acquisition and false acquisition to PN code sidebands, including multipath. Multipath is defined as specular reflections with path delay > 700 nsec and < 5 msec, and < -6 dB with respect to the direct signal.	The focus is on the DMU acquisition algorithm. The analysis will determine if 'Largest of detection' is employed and if the False Acquisition test is sufficient to guard against multipath.	The analysis must show that the multipath cannot cause a false acquisition.	(See Section 2.6.2 for additional details) The probability of false acquisition due to noise only is ~2.4 x 10^{-6} The probability of false acquisition due to worst case multipath is 5 x 10^{-5} Thus, DAS provides substantial mitigation against false acquisition due to noise and multipath	Pass
255	3.2.4.2.1.16.b	The most recent commanded tracked frequency offset shall be used to aid reacquisition.	The reacquisition algorithm (DSP firmware code) will be analyzed to determine what frequency is used for the 'mini acquisition' process conducted for reacquisition. The last tracked frequency is in	The design analysis must indicate that the most recent value in reacquisition corresponds to that last tracked in the carrier tracking loop.	(See Section 2.6.3 for additional details) Based on the SDD, the design analysis showed that the most recent value in reacquisition corresponds to that last tracked in the carrier tracking loop	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
			the accumulator of the 2^{nd} order loop filter.			
256	3.2.4.2.1.16.c	Reacquisition time shall be less than or equal to the initial acquisition times specified in Section 3.2.4.2.1.7.c and 3.2.4.2.	The acquisition algorithm will be analyzed (DSP firmware code) to determine that a reduced number of PN Code windows are being used for reacquisition vs initial acquisition	The design analysis must indicate that fewer PN Code windows are being assessed during reacquisition than during initial acquisition.	(See Section 2.6.4 for additional details) All aspects of acquisition and reacquisition are essentially the same except for PN Code epoch search In reacquisition, the PN Code search is reduce from 4094 ½-chip states to 256 ½-chip states Thus, DAS reacquisition time is less than DAS initial acquisition time	Pass

2.6.2 Additional Analysis Details for SRD Req #238 (False Acquisition)

With reference to SRD Paragraph 3.2.4.2.1.11.a, the SRD requires that the demodulator provide protection against false acquisition, and in particular against multipath. The DAS DMU PN acquisition algorithm is described below.

As shown previously in Figure 2.1-1, after the receiver has been allocated to a user service, it automatically begins a search for signal in state S4. There are in fact 2 primary steps that are performed prior to declaring signal detection.

In Step 1, the receiver is performing a PN Code search using a PN Match Filter (PNMF) to achieve rapid acquisition via the inherent parallel processing of this approach. The PNMF consists of a maximum 256 stages (with every second stage tapped) clocked at 2x PN chip rate. Thus, only a fraction of the 4094 ½-chip states can be processed simultaneously (i.e., parallel processed). The full PN Code is thus segmented into ‘PN windows’, of which there are 16 (=4097/{2*128}) to cover the entire PN code.

The PN windows are stepped through sequentially until one of the windows produces a magnitude that exceeds a threshold, which is set at TH1 = 4.5 σ (σ^2 = noise variance or power). This is known as the threshold-crossing event. The code phase that corresponds to the largest magnitude within the PN window that exceeds threshold is known as the peak code phase.

A false PN acquisition test follows a threshold-crossing event. In the false PN acquisition test, the PN window is set up to dwell on the peak code phase along with four of its adjacent ½-chip states to again determine if the correlation peak crosses a threshold TH2 = 4.0 σ.

The false-acquisition protection that is provided by the signal search process is quantitatively assessed below. This assessment is conservative, because in addition to the protection provided by the PN acquisition process, there is in fact protection provided by the carrier acquisition process (analysis of which is not included since the PN acquisition process meets the false signal detection requirement).

For the initial threshold test (TH1), we have that the probability that a noise-only correlation exceeds the threshold is:

$$P_{11} = \exp(-TH_1/2)/\mathrm{sqrt}(2\pi\sigma^2)$$
$$= \exp(-4.5^2/2)/\mathrm{sqrt}[2\pi(4.5)^2]$$
$$\sim 3.6\text{x}10^{-6}.$$

The probability that any noise correlation out of the 4094 ½-chip states crosses threshold TH_1 is:

$$P_{12} = 1- [1-3.6\text{x}10^{-6}]^{4094}$$
$$\sim 1.5 \text{ x } 10^{-2}.$$

For the false alarm test, only 5 states are tested so that the probability of a noise only correlation sample crossing threshold is:

$$P_{21} = \exp(-TH_2/2)/\mathrm{sqrt}(2\pi\sigma^2)$$
$$= \exp(-4.0^2/2)/\mathrm{sqrt}[2\pi(4.0)^2]$$
$$\sim 3.3\text{x}10^{-6}.$$

The probability that any noise correlation out of the 5 ½-chip states crosses threshold TH_2 is:

$$P_{22} = 1- [1-3.3\text{x}10^{-6}]^{5}$$
$$\sim 1.7 \text{ x } 10^{-4}.$$

Thus the total probability of false acquisition due to noise only is:

$$P_F = P_{12}*P_{22}$$
$$\sim 2.4\text{x}10^{-6}.$$

The preceding discussion treated noise only conditions, but SRD Paragraph 3.2.4.2.1.11.a of Table 2.6-1 also requires that the demodulator provide protection against multipath. Multipath is defined as: "specular reflections with path delay > 700 nsec and < 5 msec, and < -6 dB with respect to the direct signal." The PN chip rate ~ 3 Mcps, so that a ½-chip state ~ 0.17 μsecs. All multipath components less than ~ 0.17 μsecs would effectively ‘add’ to the desired epoch state. Those of concern are associated with longer delays. The LOD algorithm automatically mitigates against multipath because the direct path is 6 dB stronger that any multipath component. A false acquisition due to multipath in Step 2 of the algorithm requires that the noise component of the multipath be greater than 6 dB than the noise associated with the true epoch. It can be shown that the density (x) of the ratio of independent Gaussian Random Variables of zero mean and equal variance is [10, p.47]:

$$f(x) \quad = \quad 1/[\pi\,(1+x^2)].$$

Under worst case conditions, a single multipath component may be associated with a correlation peak that is at most 6 dB below the desired epoch. The probability (P_{m1}) of this occurring is then:

$$P_{m1} \quad = \quad \int_{2}^{\infty} f(x)dx$$

$$= \quad \int_{2}^{\infty} 1/[p\,(1+x\cdot x)]dx$$

$$= \quad (1/\pi)\,[\tan^{-1} x];\ x\ \varepsilon\ [2, \infty] \qquad [11,p.311]$$

$$= \quad (1/\pi)\,[\tan^{-1}\infty\ -\tan^{-1} 2]$$

$$\sim \quad 0.15.$$

The probability (P_{m2}) of a multipath component then exceeding the false acquisition threshold ($TH_2 = 4\ \sigma$) is the probability of a Gaussian random variable with SNR =-2.5 dB (= 4.5 -6 dB) exceeding the 4σ threshold. A –2.5 dB SNR means that:

$$½\ m^2/\sigma^2 = \quad -2.5\text{ dB} \sim 0.56$$

$$m \quad \sim \quad 1.1\ \sigma$$

$$P_{m2} \quad = \quad \exp\,(-TH_1/2)/\mathrm{sqrt}(2\pi\sigma^2)$$

$$= \quad \exp(-3.4^2/2)/\mathrm{sqrt}[2\pi(3.4)^2]$$

$$\sim \quad 3.6\mathrm{x}10^{-4}.$$

Accordingly, the probability that a multipath component is falsely acquisitionuired (Pm) is given by:

$$P_m \quad = \quad P_{m1}\ \mathrm{x}\ P_{m2}$$

$$\sim \quad 5\ \mathrm{x}\ 10^{-5}.$$

2.6.3 Additional Analysis Details for SRD Req #255 (Reacquisition Frequency)

With reference to SRD Paragraph 3.2.4.2.1.16.b, the SRD requires that the most recent commanded tracked frequency offset shall be used to aid reacquisition. The tracking scheme uses Doppler correction as described in Figure 2.6-1. Doppler correction is applied throughout the tracking and reacquisition process. Consequently, the center frequency used for reacquisition is the commanded frequency provided at initial acquisition modified by the existing computed Doppler frequency. It is this frequency that is used as center of the acquisition window. This is can be seen directly in the DAS DMG SDD ([15], Paragraph 5.5.4), in which the frequency in Step 2 for both PN and carrier acquisition is based on "…calculate the Doppler frequency for the carrier and the chip rate."

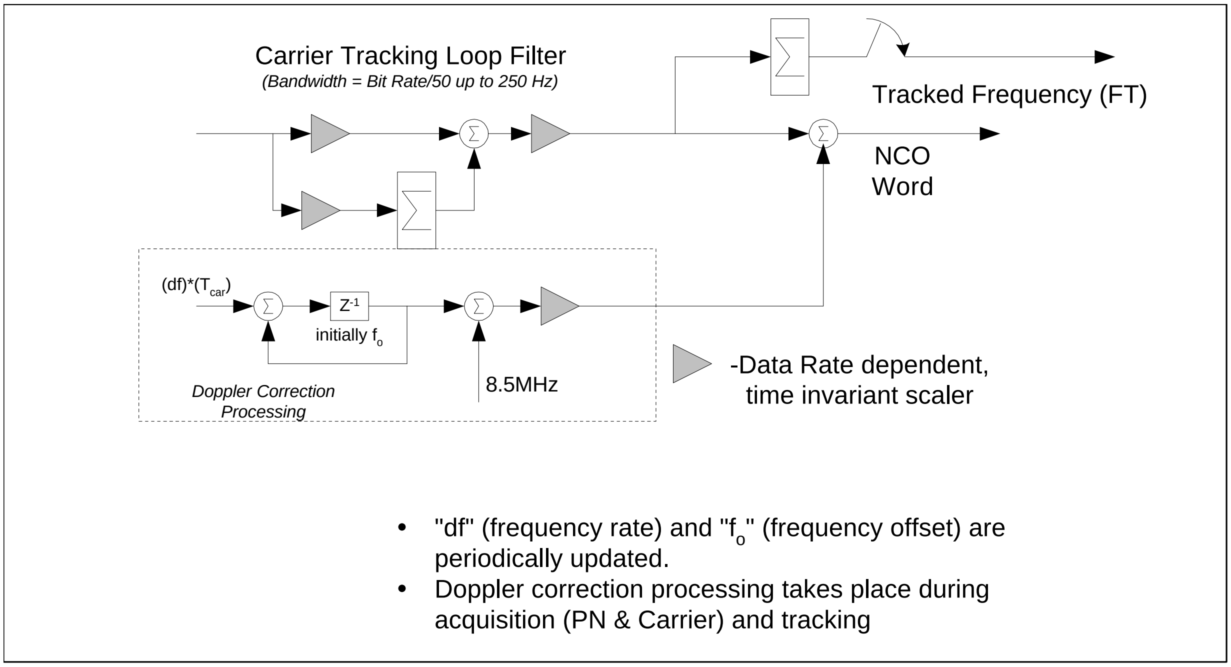

Figure 2.6-1: Carrier Tracking Scheme with Doppler Correction

2.6.4 Additional Analysis Details for SRD Req #256 (Reacquisition Time)

With reference to SRD Paragraph 3.2.4.2.1.16.c, the SRD requires that reacquisition time less than or equal to the initial acquisition time. The DAS reacquisition scheme is similar to that used in the initial acquisition process described earlier Section 2.6.2, except that only one PN window is required. This means that the PN search component of acquisition is reduced by a factor of ~16 over initial acquisition.

The FFT carrier acquisition assumes the original frequency uncertainty of either Mode A or B (as scheduled by SWSI). Although it could be argued that the frequency uncertainty has been narrowed considerably after initial acquisition, there is negligible time penalty incurred under this assumption due to the processing efficiency of the FFT. The tracking loops will close statistically at the same rate as during initial acquisition because the bandwidths are the same and the parameter offsets (phase, bit timing and PN code epoch offset) after reacquisition is the same as after initial acquisition.

Note also that the initial acquisition algorithm does rely on any known a priori symbol sequence as an acquisition aid. This of course is the case for reacquisition since the user transmitter keeps transmitting independent of the DAS receiver state.

In summary, reacquisition time will be less than initial acquisition because of the reduction in PN Code search range, which is reduced from 4094 ½-chip states to 256 ½-chip states.

2.7 ANALYSIS CASE 6: RETURN DATA HANDLING

2.7.1 Summary (3 Requirements)

The objective of Analysis Case 6 is to verify requirements related to Return Data handling. Specific requirements that are to be verified are listed below in Table 2.7-1. As indicated in Column 7 of Table 2.7-1, all requirements have been successfully verified.

Table 2.7-1: Analysis Summary for Case 6 (Return Data Handling)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
95	3.1.5.2.2.a	The DAS shall have a defined maximum allowed storage duration.	The analysis will examine the database field and the PTP code that implements the maximum allowed storage duration.	The design analysis must show that code exists to support the defined maximum allowed storage duration.	Upon review of the database design and Schema Specification a max storage duration parameter was defined as having a range of values from 3 to 30 days.	Pass
269	3.2.5.2.1.a	The DAS shall provide no less than 100 Mbytes of storage space to archive return data.	The analysis will examine the range validation of the PTP disk usage set at a maximum of 95%, leaves 5% of 36 GB always available to all users by design.	The design analysis must show that DAS has no less than 100 Mbytes of storage space to archive return data	DASCON provides 72 GB of total storage space for DAS customer data. At 95% full capacity, file purging begins. That leaves 68.4 GB of effective storage space out of 72 GB. Assuming there are 50 customers, that provides ~ 1.37GB of storage space per customer, well in excess of the 100Mbyte requirement.	Pass
283	3.2.7.1.h	The DAS shall maintain system status log data for at least 45 days.	The backup database script has a variable that determines how many days to maintain system status.	The design analysis must show that DAS maintains system status log data for at least 45 days.	O&M Manual, Section 5.3.2.2.4 provides details on the backup procedures for delog of status data. According to the procedure, the database status tables are designed to hold 24 hours of status data, and up to 45 files are maintained on the hard drive. As part of the delog procedures a check is made by a utility to check for file dates	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
					older than 45 days from the current date. These old files are then removed from the archived files on the hard disk.	

2.8 ANALYSIS CASE 7: RMA

2.8.1 Summary (9 Requirements)

The objective of Analysis Case 7 is to verify requirements related to reliability, availability (Inherent and Operational) and maintainability requirements. Specific requirements that were verified are listed below in Table 2.8-1. Note that the detailed analysis for the RMA requirements is documented in the RMA Report [12]. As indicated in Column 7 of Table 2.8-1, all requirements have been successfully verified.

Table 2.8-1: Analysis Summary for Case 7 (RMA)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
290	4.1.1.a	The Parts Count Reliability prediction method of MIL-HDBK-217 shall be used in the initial stages of system design.	The RMA analysis will be examined to determine the approach that was used in the RMA allocation process for PDR.	The analysis must show that MIL-HDBK-217 was used in the RMA analysis for PDR.	The DAS RMA Initial Prediction was conducted using the Parts Count prediction method of MIL-HDBK-217F and documented in the DAS RMA Initial Prediction Report as such.	Pass
291	4.1.1.b	The reliability prediction method shall shift to the Parts Stress Analysis Prediction method, or other reliability modeling technique approved by NASA, at the time when a firm, detailed parts list is available	The RMA analysis will be examined to determine the approach used in the RMA prediction process conducted for CDR.	The analysis must show that the Parts Stress Analysis Prediction method or other approved method was used in the RMA analysis for CDR.	The Parts Stress Analysis prediction only applies to the custom items (DMG and FO Switch), since no detailed design data is provided by the developer/vendor. MTBF values provided by the COTS vendors were used in the RMA assessment. The Parts Stress Analysis prediction was not conducted for the custom items. However, the Parts Count Reliability prediction method of MIL-HDBK-217, which was used, was very detailed [12].	Pass
292	4.2.1.a	A Maintainability Status Report shall be provided in accordance with Task 104 of MIL-HDBK-470a, Designing and Developing Maintainable Products and Systems, and include any changes in predicted maintainability parameters	The RMA report will be examined in the context of the requirements imposed by MIL-HDBK-470a.	The analysis must show compliance with MIL-HDBK-470a including all changes in predicted maintainability parameters.	A Maintainability Status Report was not conducted. However for the verification of 4.2.1.b in Qual Test Q4.5, each LRU will be removed and replaced to empirically determine the MTTR value	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
294	4.2.1.c	The maximum time to repair shall not exceed 1 hour for the 90th percentile of failures.	All LRUs shall be removed and then reinserted. The time to accomplish this shall be measured. The mean time shall be computed based on the initial and final operating conditions of DAS.	The analysis must show that the maximum time to repair shall not exceed 1 hour for the 90th percentile of failures.	Based on the RMA report (Appendix 2-A) [12], the maximum time to repair is 60 minutes for the IBUG and DMG Chassis, while all other LRUs are < 30 minutes. This, combined with the FMEA [12] implies that the maximum time to repair does not exceed 1 hour for the 90th percentile of failures. Note that a fixed 1 hour for fault isolation time was added to the Mechanical and Power CI in the calculation of availability [12, Section 5.3].	Pass
296	4.2.2.a	Failures shall be isolated to one chassis or Line Replaceable Unit (LRU), whichever is smaller. Manual intervention can be used to isolate failures to below the chassis or LRU level.	The FMEA will be examined to assess the consequence of each failure or fault.	The analysis must show that sufficient monitoring is in place that will allow isolation to the LRU level.	The FMEA [12] provided the following conclusions: All failures that were identified resulted in conditions such that the resulting status monitoring led to the identification of a single LRU which was at fault The FMEA reviewed each failure and identified which failures were flagged by status monitoring, and nearly all were flagged appropriately. The FMEA considered failures to the LRU level. Failures were identified that required manual intervention. Designers verified that sufficient operational procedures exist to mitigate the identified failures.	Pass
298	4.3.a	The inherent availability for any period of 10,000 hours shall be 0.995.	The existing RMA analysis presented at CDR will be examined to determine the DAS inherent availability.	The analysis must show that the DAS inherent availability for any period of 10,000 hours is ≥ 0.995.	The DAS RMA Initial Prediction Report showed that the DAS Inherent Availability, Ai, for any period of 10,000 hours is: WSGT: 0.9996 GRGT: 0.9997 These values > 0.995 so the requirement has been satisfied	Pass
299	4.4.a	For each DAS there shall be a communications path from the output of the EMC to the Data routing and Archiving external interface, such that the operational availability, measured over a 10,000 hour interval is 0.9999. Redundant paths may be used in achieving this Ao	The existing RMA analysis presented at CDR will be examined to determine the DAS operational availability.	The analysis must show that the DAS operational availability, measured over a 10,000 hour interval is ≥ 0.9999.	The DAS RMA Initial Prediction Report showed that the DAS Operational Availability, Ao, for any period of 10,000 hours is: WSGT: 0.9998 GRGT: 0.9999 The value for WSGT is only 0.0001 less than the required 0.9999. In the prediction analysis, the MTTRs for all LRUs were given a minimum floor of 10 minutes. This is overly pessimistic for those LRUs that are simply card replacements within a chassis slot. With these considerations in mind, it is therefore concluded here that DAS meets	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
					the required availability requirements	
300	4.4.1.a	Available service time is measured over a contiguous 10,000 hour interval except that any loss of availability due to loss of facility services such as power or air conditioning, or loss of system capability resulting from unusual weather conditions, such as icing or severe rain storms, shall not be counted.	The existing RMA analysis presented at CDR will be examined to determine what factors were included in the down time.	The analysis must show that the DAS operational availability does not include loss of facility services.	The DAS RMA Initial Prediction Report only considered the MTBFs and MTTRs for the DAS CIs and did not consider loss of availability due to facility services outages. The DAS RMA analysis does not include loss of facility services.	Pass
301	4.4.1.b	The time service is not available shall include all times service is not available due to corrective maintenance downtime, administrative downtime, logistics supply downtime, and preventive maintenance downtime.	The existing RMA analysis presented at CDR will be examined to determine what factors were included in the down time.	The analysis must show that the DAS operational availability includes loss time due to all the factors specified in Paragraph 4.4.1.b.	The DAS RMA Initial Prediction Report considered service loss due to maintenance, administrative and logistics related activities, which was combined into the 1 hour fault isolation time for the Mechanical and Power CI.	Pass

2.9 ANALYSIS CASE 8: TRAINING

2.9.1 Summary (9 Requirements)

The objective of Analysis Case 8 is to verify requirements related to the DAS training program. Specific requirements that were verified are listed below in Table 2.9-1. As indicated in Column 7 of the table, all requirements have been successfully verified.

Table 2.9-1: Analysis Summary for Case 8 (Training)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
332	8.1.a	Training policies, plans and procedures shall provide for orderly transition into sustained operations and maintenance.	The DAS Training Plan and training materials will be analyzed to show orderly transition into sustained operations and maintenance.	The analysis must show that there is detailed instruction relative to powering-up and maintaining the DAS equipment.	The DAS Training Plan provides a comprehensive course of instruction on DAS operations and maintenance procedures as defined in the DAS O&M Manual. Therein, system power up, operator functions, and maintenance activities necessary for an orderly transition into sustained operations are included.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
333	8.2.a	Training shall prepare operations and maintenance personnel, including both Government and contractor employees, to operate, maintain, and support the DAS	The DAS Training Plan and training materials will be analyzed to show that operations and maintenance personnel can operate and provide Level 1 maintenance of DAS.	The analysis must show that there is detailed instruction relative to operating and providing Level 1 maintenance for the DAS equipment.	Section 4.1.2.1.4 of the Training Plan provides an outline for the DAS Training Materials. In the outline, 15 hours out of a total of 40 hours of instruction are devoted to Level 1 maintenance of DAS equipment, and 16 hours are dedicated to operations.	Pass
334	8.2.b	Operations personnel shall be trained to perform operations functions in accordance with WSC Local Operations Procedures (LOPs)	The DAS Training Plan and training materials will be analyzed with regard to WSC LOPS.	The analysis must show that there consistency between the training materials and the WSC LOPs.	WSC LOPs are TBD. In section 5.3 of the DAS O&M Manual, operating procedures are defined that will be used as the basis for developing WSC LOPs related to DAS.	Pass
335	8.2.c	Maintenance technicians shall be trained to maintain DAS subsystems in order to meet the maintainability requirements.	The DAS Training Plan and training materials will be analyzed to show Level 1 maintenance training will be provided.	The analysis must show that there is detailed instruction provided in the training to maintenance technicians relative to operating and providing Level 1 maintenance of the DAS equipment.	Section 4.1.2.1.4 of the Training Plan provides an outline for the DAS Training Materials. In the outline, 15 hours out of a total of 40 hours of instruction are devoted to Level 1 maintenance of DAS equipment, and 16 hours are dedicated to operations.	Pass
336	8.2.d	The maximum amount of training shall be performed at the WSC. Training shall be conducted at other sites, such as vendor facilities, when it is cost effective to the Government, e.g., to take advantage of existing courses and training facilities	The DAS Training Plan will be analyzed to show training at WSC is maximized.	The analysis must show that the plan indicates where the training is to occur and that it is primarily at WSC.	With the exception of 1 week of System-level training at GRGT, all Basic Operator and Maintainer courses and all Level 2 maintenance courses are scheduled to be taught at WSC. Table 2-2 in the Training Plan indicates the scheduled times and locations of the training courses.	Pass
337	8.2.e	The course material shall be modularized, individualized, and use multimedia learning resources including manuals, study guides, workbooks and audiovisual materials as appropriate	The DAS Training Plan and training materials will be analyzed.	The analysis must show that the training material is modularized, individualized, and uses multimedia learning resources, as appropriate.	As described in Section 4 of the Training Plan and as determined upon review of the Training Materials developed to date, the course material is being developed in modularized units of instruction, which progressively build upon the information presented in previous units. Additionally, students will be given a study guide, an O&M Manual, and workbooks for individual note-taking, study and future reference. Hands-on demonstrations with DAS equipment and CD versions of the O&M Manual will be incorporated into the course to facilitate multimedia learning.	Pass
338	8.2.f	The initial training program shall concentrate on maintenance and operations.	The DAS Training Plan and training materials will be analyzed to show focus on system level operations and maintenance.	The analysis must show that the training material initially focuses on maintenance and operations.	An analysis of the training course outline indicates a total of 31 hours out of 40 hours shall concentrate on DAS operations (16 hours) and Maintenance (15 hours)	Pass
339	8.2.g	Students for further training programs shall include NASA instructors, cognizant NASA technical personnel, NASA system engineer and WSC Operations and Maintenance (O&M) contractor personnel.	The DAS Training Plan will be analyzed.	The analysis must show that the training plan includes: NASA instructors, cognizant NASA technical personnel, NASA system engineer and WSC Operations and Maintenance (O&M) contractor personnel.	Section 6 of the Training Plan provides a profile which describes the skills and experience required of the student personnel as provided by NASA. This includes: NASA technical personnel (DB operators, SMTF personnel, HMD techs), NASA Instructors, and WSC O&M personnel (TOCC operators and LMTs)	Pass

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Analysis Findings	Pass or Fail
351	8.4.2.e	Software-unique maintenance training shall include debugging techniques and high order language (HOL) use	The DAS Training Plan and training materials will be analyzed to that it includes debugging techniques and high order language (HOL) use.	The analysis must show that the training material includes debugging techniques and high order language (HOL) use.	Analysis of the Level 2 software maintenance course indicates debugging will be taught. See course objective 7.3 which indicates that troubleshooting and fault diagnostics will be taught. High Order Language, other than those languages used in DAS coding, are not taught and not required.	Pass

2.10 ANALYSIS CASE 9: MAINTENANCE

2.10.1 Summary (13 Requirements)

The objective of Analysis Case 9 is to verify requirements related to the DAS maintenance program. Specific requirements that were verified are listed below in Table 2.10-1. As indicated in Column 7 of the table, all requirements have been successfully verified except for 5 pending Level2 documentation.

Table 2.10-1: Analysis Findings for Case 9 (Maintenance)

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Analysis Findings	Pass or Fail
355	9.2.a	Procedures shall be developed using 500-tip-2111, Content Specification for Operation and Maintenance Manuals, as a guideline.	The DAS Level 1 O&M Manual will be reviewed and assessed with regard to the guidelines in 500-tip-2111 and only in the context of Level 1 procedures.	The analysis must show that the O&M manual conforms to the guidelines in 500-tip-2111.	A review of the DAS O&M Manual content indicates that the guidelines in 500-tip-2111 were followed.	Pass
356	9.2.b	Any state-of-the-art techniques that are developed for the DAS shall be included in the procedures.	Currently, there are no state-of-the-art techniques that have been uniquely developed for the DAS. Only Level 1 procedure would apply.	Not Applicable as long as there are no state-of-the-art techniques that have been uniquely developed for the DAS.	There are no state of the art techniques unique to DAS that have not been included in the O&M Manual or Training Material. Proprietary information will be provided when an appropriate NDA is in place.	Pass
358	9.2.1.2.a	First level maintenance shall include scheduled preventive maintenance.	The DAS O&M manual will be analyzed to show that first level maintenance includes scheduled PM.	The analysis must show that preventative maintenance activities are included in the Level 1 O&M manual.	Section 6.4 of the DAS O&M Manual describes Preventive Maintenance Techniques for DAS. Table 6.4-1 in the O&M Manual lists the components of DAS requiring Preventive Maintenance.	Pass
359	9.2.1.2.b	First level maintenance shall include fault isolating to the level of an LRU.	The DAS O&M manual will be analyzed show that first level maintenance includes fault isolating to the LRU level.	The analysis must show that fault isolating to the level of an LRU is included in the Level 1 O&M manual.	Section 6.9 of the O&M Manual contains fault analysis and troubleshooting procedures specific to each subsystem within DAS. Fault isolation is described at the LRU level.	Pass
360	9.2.1.2.c	Fault isolation to the level of a line replaceable item within an LRU (if any) shall be performed if the time required is consistent	The DAS O&M manual will be analyzed show that Fault isolation to the level of a line replaceable item within an LRU (if any) is performed if the time	The analysis must show that Fault isolation to the level of a line replaceable item within an LRU (if any) is performed if the time	There are no fault isolation procedures below the LRU level (Section 6.12 of the O&M Manual)	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
		with the operational maintainability requirement	required is consistent with the operational maintainability requirement	required is consistent with the operational maintainability requirement is included in the Level 1 O&M manual.		
361	9.2.1.2.d	First level maintenance shall include replacement of a failed LRU or line replaceable element within an LRU.	The DAS O&M manual will be analyzed to show that first level maintenance includes replacement of a failed LRU.	The analysis must show that replacement of a failed LRU is included in the Level 1 O&M manual.	Section 6.12 and in particular Table 6.12-1 provides the repair and replacement procedures for each LRU in each subsystem in DAS	Pass
362	9.2.1.2.e	First level maintenance shall include testing to ensure that the system/subsystem has been restored to operational condition.	The DAS O&M manual will be analyzed to show testing is documented to ensure that the system/subsystem has been restored to the proper operational state.	The analysis must show after replacement of a failed LRU that checkout procedures are provided.	Replacement procedures for LRUs are described in Section 6.12. In general, these procedures cover up through applying power to the component or up to when power is supplied for hot-swappable components. From there, power on procedures in section 5.3 can be followed to ensure proper BIST and boot up procedures are implemented.	Pass
363	9.2.1.2.f	First level maintenance shall include alignment and tuning.	The DAS O&M manual will be analyzed to show that tuning and alignment procedures are provided.	The analysis must show that alignment and tuning are included in the Level 1 O&M manual (as necessary).	No alignment and tuning is required.	Pass
364	9.2.1.3.a	Second level maintenance actions shall include localization of a failure to the piece-part or equipment component level, as appropriate	The DAS O&M manual will be analyzed	The analysis must show that localization of a failure to the piece-part or equipment component level, as appropriate is included in the Level 2 O&M manual.	Level 2 Documentation drafts are in development. Cannot verify until drafts are available.	TBD
365	9.2.1.3.b	Second level maintenance actions shall include disassembly and removal of the failed piece-part or equipment component.	The DAS O&M manual will be analyzed	The analysis must show that disassembly and removal of the failed piece-part or equipment component is included in the Level 2 O&M manual.	Level 2 documentation drafts are in development. Cannot verify until drafts are available.	TBD
366	9.2.1.3.c	Second level maintenance actions shall include replacement of failed elements and reassembly.	The DAS O&M manual will be analyzed	The analysis must show that replacement of failed elements and reassembly is included in the Level 2 O&M manual.	Level 2 documentation drafts are in development. Cannot verify until drafts are available.	TBD
367	9.2.1.3.d	Second level maintenance actions shall include bench testing to ensure performance to the specified level.	The DAS O&M manual will be analyzed	The analysis must show that bench testing to ensure performance to the specified level e is included in the Level 2 O&M manual.	Level 2 documentation drafts are in development. Cannot verify until drafts are available.	TBD

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Analysis Findings**	**Pass or Fail**
368	9.2.2	Software maintenance, including debugging, modification, and enhancement of system software packages, shall be performed in the SMTF	The DAS O&M manual will be analyzed	The analysis must that Software maintenance, including debugging, modification, and enhancement of system software packages is performed in the SMTF.	Level 2 documentation drafts are in development. Cannot verify until drafts are available.	TBD

3. INSPECTION CASES

3.1 OVERVIEW

As approved by the NASA DAS Product Manager, the inspection verification method is defined as:

Inspection is the method used to verify the physical characteristics of the product (e.g., size, weight, appearance, adherence to specified standards and engineering practices, and quality of design and construction) by examining the equipment in comparison with associated documentation. Inspection determines conformance to requirements without the use of special test equipment or analysis techniques. In conducting inspections, verification personnel shall: 1) Use inspection tools and measurement devices to perform a visual survey of the product; and 2) Note the results of their inspection for comparison with the required physical characteristics of the product. Inspections may be performed during any assembly stage of the product.

3.1.1 Summary

Section 3 addresses the DAS inspection cases, as identified in the DAS Verification Plan [3] and summarized in Table 3.1-1. Note that Column 5 of the table summarizes the results of the inspections for each case. Each of these cases is detailed individually in the subsections that follow. As indicated all cases have been verified successfully. The verification of 15 requirements is pending completion of SAT.

Table 3.1-1: Summary of Inspection Cases 1-11

1	2	3	4		5	6	7
Inspection Case #	**Inspection Title**	**Number of SRD Reqmts to be Verified**	**# Reqmts that Failed**	**# Reqmts Required Completion of SAT**	**A&I Report Section**	**SE Signoff (Date)**	**QA Signoff (Date)**
I1	Beamforming	21	0	0	3.2	TB (10-18-01)	
I2	Status Indicators	1	0	0	3.3	TB (10-19-01)	
I3	Design & Construction	14	0	3	3.4	TB (10-22-01)	
I4	EMI	3	0	0	3.5	TB (10-22-01)	
I5	Installation	10	0	3	3.6	SJ (11-26-01)	
I6	Training	14	0	0	3.7	CH (6-12-02)	
I7	Sparing	8	0	2	3.8	CH (6-17-02)	
I8	Security	6	0	6	3.9	Pending SAT	
I9	PTP Processing and Routing	11	0	0	3.10	WK (10-31-01)	
I10	WSC Interface	1	0	0	3.11	SJ (08-28-02)	
I11	WSC Interface	1	0	1	3.12	Pending SAT	
	Total =	**90**	**0**	**15**			

3.2 INSPECTION CASE 1: BEAMFORMING

3.2.1 Summary (16 Requirements)

The objective of Inspection Case 1 is to verify requirements related to beamforming. Specific requirements to be verified are listed below in Table 3.2-1. As documented in Columns 5 and 6 of the DAS Verification Planning Table (Appendix D of the DAS Verification Plan [3]), all requirements under Inspection Case 1 have the same 'verification approach and success criteria; that is:

Verification Approach Description: The IBUG is COTS: the inspection will check the corresponding requirement in the TGBFS Specification and the set of TGBFS deviations/waivers.

Success Criteria: The inspection must show that the requirements are the same and that no deviations/waivers exist for this requirement. As indicated in Column 6 of Table 3.2-1, all requirements have been successfully verified.

Table 3.2-1: Inspection Findings for Case 1 (Beamforming)

1	2	3	4	5	6
Req ID	**SRD Sec. #**	**SRD Requirement**	**Corresponding TGBFS Specification Requirement [13]**	**TGBFS Verification Case**	**Pass or Fail**
58	3.1.3.1.b	The DAS shall support the Pointing beamforming modes.	3.3.3.a The IBU shall adjust the phase and amplitude of up to 30 separated element signals and combines them to effect formation of a main beam in the direction of each user. [There are no deviations/waivers for this TGBFS requirement]	TC 2.1	Pass
59	3.1.3.1.c	The DAS shall support the Adaptive beamforming mode.	3.4.2.6.2 The TGBFS shall automatically null interfering signals by implementing an algorithm that maximizes the user signal to interference plus noise ratio in the 6 MHz channel bandwidth. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
60	3.1.3.1.d	The DAS shall support the Fixed Weight beamforming mode.	3.4.2.5 Each IBU shall be capable of operating in a mode in which commanded element weights are directly provided via the Control interface. [There are no deviations/waivers for this TGBFS requirement]	TC 1.3	Pass
63	3.1.3.1.g	The DAS shall weight and sum signals from selected EMC(s).	3.3.2.a The EMC shall provide the element channel data and element channel inverted correlation matrix to IBUs. 3.3.3.a The IBU shall adjust the phase and amplitude of up to 30 separated element signals and shall combine them to effect formation of a main beam in the direction of each user. [There are no deviations/waivers for this TGBFS requirement]	TC 2.1	Pass
64	3.1.3.1.h	The DAS shall output the weighted-sum signal(s).	3.3.3.b The IBU shall pass the formed beams, in both analog and digital form, to a respective receiver for user signal demodulation and additional processing. [There are no deviations/waivers for this TGBFS requirement]	TC 2.8	Pass

1	2	3	4	5	6
Req ID	**SRD Sec. #**	**SRD Requirement**	**Corresponding TGBFS Specification Requirement [13]**	**TGBFS Verification Case**	**Pass or Fail**
65	3.1.3.1.i	The DAS shall switch out any of the element channels upon request.	3.3.1.1.b The TGBFS shall have the capability to switch out one or more element signal channels by request via the control interface. [There are no deviations/waivers for this TGBFS requirement]	TC 1.1	Pass
66	3.1.3.1.j	The DAS shall automatically null interfering signals, when in adaptive nulling mode.	3.4.2.6.2 The TGBFS shall automatically null interfering signals by implementing an algorithm that maximizes the user signal to interference plus noise ratio in the 6 MHz channel bandwidth. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
170	3.2.3.1.a	The DAS shall form a beam such that the C/No of the formed beam is within 0.5 dB of the algebraic sum of the individual C/No's of the 30 element channels.	3.4.2.1.1 The C/No of the formed beam from each IBU shall be within 0.5 dB of the algebraic sum of the individual C/No's of the 30 element channels with the availability specified in Paragraph 3.4.5.1. [There are no deviations/waivers for this TGBFS requirement]	TC 2.3	Pass
171	3.2.3.1.b	The DAS shall generate weights such that the calculated transfer function (gain and phase) of the sum signal does not change as a result of the update, as long as the calibration vector is constant.	3.4.2.1.4 IBU weight updates shall be implemented in such a manner that the calculated transfer function (gain and phase) of the IBU for signals coming from the commanded beam pointing direction does not change as a result of the update; this calculated transfer function does not include errors due to imperfect calibration. [There are no deviations/waivers for this TGBFS requirement]	A3	Pass
172	3.2.3.1.c	The DAS shall form simultaneous independent beams independently.	3.4.2.2 Each IBU in the TGBFS shall form beams independently. [There are no deviations/waivers for this TGBFS requirement]	TC 2.2	Pass
173	3.2.3.1.d	The DAS shall have the capability of forming a beam centered at any commandable angle within a cone of 27 degrees solid angle centered on the boresight of the TDRS MA antenna array.	3.4.2.3 The TGBFS shall have the capability of forming a beam centered at any commandable angle within a cone of 27 degrees solid angle centered on the boresight of the TDRS MA antenna array. [There are no deviations/waivers for this TGBFS requirement]	TC 2.5	Pass
174	3.2.3.1.e	The DAS shall output a beamformed signal with an output signal level of -4 dBm plus or minus 2.0 dBm for a nominal input signal level of –20dBFS.	3.5.4.1.1.c Signal Level: 0 dBm ± 2 dB. For an average input power level of -32 dBm per element [There are no deviations/waivers for this TGBFS requirement] Note: The nominal element signal level = -36 dBm [4]; Page 52, Figure 40), so that the output signal level for this nominal input is -4 dBm lower than when the input power = -32 dBm. Accordingly, The nominal output power= -4 dBm as required. The IBUG is linear over its dynamic range (see SRD #175 below in this table)	TC 2.7	Pass
175	3.2.3.1.f	The DAS shall output a beamformed signal that linearly follows the input signal level (within plus or minus 0.5 dB) over the dynamic range of -12.3dB to +4dB about the nominal input signal level of –	The data sheets for the IBUG Model 5123 states that the following; “dynamic range = 19 dBm to + 7 dBm (linear with input)”	NA	Pass

1	2	3	4	5	6
Req ID	SRD Sec. #	SRD Requirement	Corresponding TGBFS Specification Requirement [13]	TGBFS Verification Case	Pass or Fail
		20dBFS.			
176	3.2.3.1.g	The DAS shall reestablish all Customer beams within 10 seconds following a loss and subsequent restoration of the EMC output signals.	3.4.2.4 The TGBFS shall re–establish all user beams within 10 seconds following a loss and subsequent restoration of the A/D Quad Splitter output signal. [There are no deviations/waivers for this TGBFS requirement]	TC 5.2	Pass
177	3.2.3.1.h	In adaptive beamforming mode, the DAS shall form a null on an interfering signal within 2 seconds from the time the covariance matrix containing the interferer is provided to DAS from the EMC.	3.4.2.6.1 The TGBFS shall form a null on an interfering signal nominally within 2 seconds from the time the EMC forms the covariance matrix. [There are no deviations/waivers for this TGBFS requirement]	A4	Pass
178	3.2.3.1.i	In adaptive beamforming mode, the DAS shall automatically null interfering signals by implementing an algorithm that maximizes the customer signal to the interference plus noise ratio in the 6 MHz BW channel.	3.4.2.6.2 The TGBFS shall automatically null interfering signals by implementing an algorithm that maximizes the user signal to interference plus noise ratio in the 6 MHz channel bandwidth. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
179	3.2.3.1.j	In adaptive beamforming mode, for a single interferer having a level of 10 dB above the average element power and located outside the main lobe, the DAS shall null the interferer by at least 10dB, for 95% of all possible combinations of main lobe positions and interferer locations for null locations which are fixed points on the surface of the earth.	3.4.2.6.3.a For a single interferer having a level of 10 dB above the average element power and located outside the main lobe, the TGBFS shall null the interferer by at least 10 dB, for 95 percent of all possible combinations of main lobe positions and interferer locations as defined below: a. The null locations are fixed points on the surface of the earth. . [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
180	3.2.3.1.k	In adaptive beamforming mode, for a single interferer having a level of 10 dB above the average element power and located outside the main lobe, the DAS shall null the interferer by at least 10dB, for 95% of all possible combinations of main lobe positions and interferer locations within the main lobe, which is defined as a cone of 3^0 solid angle, centered about the commanded pointing direction.	3.4.2.6.3.b For a single interferer having a level of 10 dB above the average element power and located outside the main lobe, the TGBFS shall null the interferer by at least 10 dB, for 95 percent of all possible combinations of main lobe positions and interferer locations as defined below: b. The main lobe is defined as a cone of 3 degrees of solid angle, centered about the commanded pointing direction [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass

1	2	3	4	5	6
Req ID	SRD Sec. #	SRD Requirement	Corresponding TGBFS Specification Requirement [13]	TGBFS Verification Case	Pass or Fail
181	3.2.3.1.L	In adaptive beamforming mode, the DAS shall update beam weights at a rate sufficient to maintain the required null depth while meeting the required beam quality, for maximum user to interferer angular velocities of 0.00033 radians per second.	3.4.2.6.4 The TGBFS shall update IBU weights at a rate sufficient to maintain the required null depth while meeting the required beam quality, for maximum user to interferer angular velocities of 0.00033 radians per second. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
182	3.2.3.1.m	In adaptive beamforming mode, the adaptive nulling requirements shall apply to (Continuous Wave) CW interferers and to interferer of any spectral composition within the 6 MHz element channel bandwidth.	3.4.2.6.5 The adaptive nulling requirements shall apply not only to CW interferers, but to interferers of any spectral composition within the 6 MHz element channel bandwidth. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass
183	3.2.3.1.n	In adaptive beamforming mode, beamforming requirements 3.2.3.1.a through 3.2.3.1.m shall apply during nulling, except for output C/No.	3.4.2.6.6.a All specified beam quality requirements shall apply during nulling, except for output C/No. [There are no deviations/waivers for this TGBFS requirement]	TC 6.1	Pass

3.3 INSPECTION CASE 2: STATUS INDICATORS

3.3.1 Summary (1 Requirement)

The objective of Inspection Case 1 is to verify requirements related to front panel status indicators. Specific requirements to be verified are listed below in Table 3.3-1. As documented in Columns 5 and 6 of the DAS Verification Planning Table (Appendix D of the DAS Verification Plan [3]), the 'verification approach and success criteria are:

Verification Approach Description: All DAS Chassis will be visually inspected.

Success Criteria: The inspection must show there are status indicators on the equipment front panels of all DAS components. As indicated in Column 7 of Table 3.3-1, all requirements have been successfully verified.

Table 3.3-1: Inspection Findings for Case 2 (Status Indicators)

1	2	3	4		5	7
Req ID	SRD Sec. #	SRD Requirement	DAS CI	DAS Chassis	Inspection Findings: Status Indicators present	Pass or Fail
114	3.1.7.1.g	The DAS shall provide status indicators on the equipment front panels of all components that constitute DAS.	EMC I/F CI	FO Switch	Custom Front Panel Display (FPD) and keypad LEDs on Power Supply cards LEDs on MCP750 CP card LEDs on PMC card	Pass

1	2	3	4		5	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**DAS CI**	**DAS Chassis**	**Inspection Findings: Status Indicators present**	**Pass or Fail**
			IBUG	IBUG (ITT 5123)	Custom Front Panel Display (FPD) and keypad LEDs on IBU cards LEDs on Power Supply cards LEDs on MCP750 CP card LEDs on Ethernet PMC card	Pass
			IF Switch	IF Switch (Universal Switching S6400C)	FPD with keypad 4 additional LEDs (Remote Operation)	Pass
			DMG	DMG (ITT 6000)	Custom Front Panel Display (FPD) and keypad LEDs on DMU cards LEDs on Power Supply cards LEDs on MCP750 CP card LEDs on Ethernet PMC card	Pass
			DSER	PTP (Avtec Systems)	Power LED HD1 LED HD2 LED	Pass
			Frequency and Timing	Brandywine IRIG Converter and 1 PPS (Brandywine GPS80J)	Single LED – 4 states	Pass
				Time code distribution Amp (Datum 6504)	LED monitoring status on all inputs and outputs	Pass
				10 MHz Frequency Amp (Datum 9611)	Alarm LED Power LED 12 Channel LEDs (Signal Loss) Selected Input Mode LED	Pass
			Mechanical and Power	Temperature Monitor (Lakeshore Model 218)	Front Panel Display showing all temperatures	Pass
				CDB Switch – Ethernet Switch (CISCO 1924)	LEDs on all ports indicate port activity LEDs for configuration and mode	Pass
				Data Switch – Ethernet Switch (CISCO 1912)	LEDs on all ports indicate port activity LEDs for configuration and mode	Pass
				GDIS Router (CISCO 2611 or 2621)	Power LED Activity LED RFS LED	Pass
				NISN Smart Hub (CISCO 2912 Switch)	LED for each of 12 channels LEDs for configuration and mode	Pass
			DASCON	933 MHZ Pentium III (Dell Power Edge 2500)	Power LED Power Supply LEDs Hard Drive status lights	Pass
			ICON	600 MHZ Pentium III Rack-mounted PC (General Technics)	Power Supply LED Hard Drive LEDs Fault Light CD Drive LED	Pass
			DCON	600 MHZ Pentium III Rack-mounted PC (General Technics)	Power Supply LED Hard Drive LEDs Fault Light CD Drive LED	Pass

3.4 INSPECTION CASE 3: DESIGN AND CONSTRUCTION

3.4.1 Summary (14 Requirements)

The objective of Inspection Case 3 is to verify requirements related to Design and Construction. Specific requirements to be verified are listed below in Table 3.4-1. As indicated in Column 8 of the table, all requirements have been successfully verified, except for three requirements that are pending SAT.

Table 3.4-1: Inspection Findings for Case 3 (Design and Construction)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
302	5.1.1.a	All chassis, subsystems and systems of new design or significantly modified design shall be designed and constructed to comply with the requirements of STDN-SPEC-4, GSFC General Requirements for STDN Electronic Equipment, or best commercial practices	The inspection is focused on the FO Switch and DMG because all other equipment is COTS. The FO Switch and DMG technical data package and the FO Switch and DMG chassis will be inspected for compliance with best commercial practices. TGBFS equipment design and construction practices shall be used as the baseline in this inspection.	The inspection must show that the FO Switch and DMG comply with best commercial practices. Adherence to STDN-SPEC-4 must be shown by comparison with delivered TGBFS equipment.	The FO Switch and DMG were compared to STDN SPEC-4 and found to comply with sections 1 to 3.5. Requirements for 3.5.5, 3.6.3, 3.6.5 through 3.13, and 3.16 were found to be not applicable. All other requirements were applicable and were either compliant with STDN-SPEC-4 requirements, compatible with established TGBFS criteria, or met using best commercial practices. See Table 3.4-2 for details on the verification method.	Pass
303	5.1.1.b	Section 3.16 of STDN-SPEC-4, Maintainability shall not apply.	This is a qualification of SRD Paragraph 5.1.1.a.	The successful verification of this requirement simply depends on the successful verification of 5.1.1.a.	Maintainability of the SRD was used in place of Section 3.16 of STDN-SPEC-4.	Pass
304	5.1.1.c	Maintainability provisions of this specification shall be used.	This is a restatement of SRD Paragraph 5.1.1.b.	The successful verification of this requirement depends on the successful verification of 5.1.1.a.	Same as that for Paragraph 5.1.1.a (SRD #302 in this table)	Pass
305	5.1.1.d	Programmable semiconductor devices in any chassis shall be handled in accordance with the provisions of STDN-SPEC-3, Specification Programming and Handling Semiconductor Devices	This requirement is valid for the DMG only. The DMG will be inspected for correct labeling and documentation provided against IAW STDN-SPEC-3 (as modified by approved deviations)	The programmable semiconductor devices on the DMG must be marked and documented as stated in STDN-SPEC-3 (except as modified by approved deviations).	All removable, programmable firmware chips (EEPROMS) used on the DMG are labeled with self-adhesive labels identifying the software version on the device. Hex and source code files are delivered in a soft format IAW deliveries provided under TGBFS.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
306	5.1.1.e	Connectors, cable, wires and other materials listed in STDN-SPEC-8, GSFC Specification for Electronic Equipment Installation Materials shall be used in the design and construction of WSC equipment. Use of materials other than those in STDN-SPEC-8 will require a waiver from the DAS Product Manager	All DAS provided connectors, cables and wires (except those provided with COTS products) will be compared to the materials listed in STDN-SPEC-8. A waiver will be developed for approval by the DAS Product Manager for material other than that listed in STDN-SPEC-8.	All connectors, cables, and wires must be purchased from the list specified in STDN-SPEC-8. All other materials used to interconnect DAS devices must be approved via a waiver by the DAS Product Manager.	All connectors, cables and wires were purchased from the list specified in STDN-SPEC-8 with some exceptions. A preliminary list of exceptions to the STDN-SPEC-8 hardware requirement were submitted to NASA GSFC for their approval in Deviation DAS-D07. A final list of all STDN-SPEC-8 exceptions will be provided at the conclusion of the program.	Pass
307	5.2.a	DAS equipment shall be mounted in electronic equipment racks which conform to STDN No. 270.5, GSFC Specification Electronic Equipment Racks	The data sheets and specs for the racks shall be inspected, as well as approved deviations associated with these racks.	The inspection must show that the racks comply with STDN No. 270.5, as modified by approved deviations associated with these racks.	The racks were inspected and found to be compliant with STDN No. 270.5, as modified by approved deviations associated with these racks. Table 3.4-3 provides a summary of the verification methods and compliance status for the DAS-supplied racks.	Pass
308	5.2.b	Tapped panel mounting holes shall be included (Section 6.8 of STDN No. 270.5).	The data sheets and specs for the racks shall be inspected. The racks and its equipment will also be visually inspected.	The inspection must show that the all tapped panel mounting holes comply with Section 6.8 of STDN No. 270.5.	Inspection has shown that all tapped panel mounting holes comply with Section 6.8 of STDN No. 270.5	Pass
309	5.2.c	If required to meet the Electromagnetic Interference (EMI) requirements for the WSC, the Electromagnetic Compatibility option (Section 6.10 of STDN No. 270.5) shall be used where necessary	In accordance with EMI requirements Paragraph 5.4.g, only FCC Class A applies for DAS chassis. With respect to the racks, the data sheets and specs for the racks shall be inspected.	The inspection must show that the racks comply with Section 6.10 of STDN No. 270.5.	The requirement for EMI compliance with STDN No. 270.5 does not apply to DAS racks because the EMI requirement is applicable only to the equipment residing within the racks. (See attached Table 3.4-3, STDN 270.5 Compliance Matrix)	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
310	5.2.d	If racks in excess of the standard 19-inch panel width are required for mounting some equipment, Section 6.14 of STDN No. 270.5 shall apply	The fully-populated racks shall be inspected and measured.	The inspection must show that all racks do not exceed the 19" maximum.	All racks were inspected and do not exceed the 19" maximum panel width.	Pass
311	5.2.e	Equipment consoles shall comply with the requirements of Section 6.18 of STDN No. 270.5. If size constraints of standard equipment require console construction that differs from the requirements of Section 6.17, or if the contractor desires to use consoles which are not in compliance with Section 6.17 of STDN No. 270.5, then a waiver will be required from the DAS Product Manager.	Console racks will not be used for DAS deployment.	NA as long as the inspection shows that DAS does not use equipment consoles as stated in Section 6.18 of STDN No. 270.5.	Inspection shows that DAS does not use equipment consoles as stated in Section 6.18 of STDN No. 270.5.	Pass
312	5.3.a	Each rack shall be provided with an input/output (bulkhead) panel in accordance with Section 3.7a of STDN-SPEC-4.	All racks shall be visually inspected.	The inspection must show that all DAS racks have the bulkheads for all inputs and outputs (except for intra-rack connectivity)	All racks have bulkhead mounted I/O panels with feed-through connections for all connections to other racks. The single exception is for IF switch interconnected analog RF connections, which will be directly connected between the IF switch and the DMGs/IBUGs. This direct connection will minimize common-mode interference to the critical analog received signal.	Pass
313	5.3.b	All cabling between DAS delivered systems and subsystems and WSC Systems shall be provided.	All cabling and connectors shall be visually accounted for and checked against all the physical requirements stated in all DAS External ICDs	The inspection must show that all cabling and connectors are accounted for and provided	Need to wait until SAT	Pending SAT

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
314	5.3.c	All mating connectors shall be supplied.	All mating connectors shall be visually accounted for and checked against all the physical requirements stated in all DAS External ICDs	The inspection must show that all mating connectors are accounted for and provided	Need to wait until SAT	Pending SAT
315	5.3.d	All cabling required to configure the systems and subsystems for checkout and in-plant testing shall be provided. This includes cabling required at the WSGT/STGT and GRGT sites for all special test equipment	All cabling required to configure the systems and subsystems for checkout and in-plant testing shall be visually accounted for and checked against installation and test procedures	The inspection must show that all cabling is accounted for and provided	Need to wait until SAT	Pending SAT

Table 3.4-2 below provides a compliance matrix showing the compliance of the FO Switch Assembly (ITT PN 185-600019-01) and the Demodulator Group (Hereinafter DMG, ITT PN 185-147007) with the SRD Requirement for its design (STDN SPEC-4, or best commercial practices). The following table provides the STDN SPEC-4 specification section, its applicability to DAS and its compliance status.

Table 3.4-2: STDN SPEC-4 Compliance Matrix

STDN SPEC-4 Section No.	Requirement	Applicable to DAS1 (Y/N)	Compliant (C) or Non-compliant (N)	Comments
1& 2	Scope and Applicable Documents	N	C	Compliant to the extent presented herein
3.1	Equipment Types and Construction	Y	C	The FO Switch and DMG are classified as rack-mounted systems
3.2.1	System Analysis and Design	Y	C	Met with COTS equipment and custom chassis. DMG designed with a top-down design for SRD compliance
3.2.2	Design Reviews	Y	C	PDR, Architecture Review, CDR and CSR all performed. Engineering drawings released.
3.2.3	Design Demonstration	Y	C	Validity of production shall be demonstrated by engineering and acceptance tests based on SRD requirements
3.3	Software	Y	C	Deliverable firmware (source code and hex files), Software Design Documents (SDD), Version Description Document (VDD), are all provided in accordance with ISO-9001. Compliance with STDN-SPEC-3 is restricted to provision of labels. Maintenance programs are restricted to BIST and status menu level LRU maintenance only.

STDN SPEC-4 Section No.	Requirement	Applicable to DAS1 (Y/N)	Compliant (C) or Non-compliant (N)	Comments
3.4.1	Structural and Mechanical	Y	C	Met by STDN 270.5 Racks
3.4.2	Rack-Mounted Systems (Chassis)	Y	C (see comments)	Chassis depths are less than 20". Ground terminals and ballbearing slides are not used on the FO Switch or DMG (per the IBUG TGBFS design). The FO Switch and DMG designs allow for rapid accessibility in fault isolation and correction.
3.4.5	Single-Rack Systems/Multiple-Rack Systems	N	-	Not applicable
3.4.5.1, 3.4.5.2	Pressurized Underfloor Cooling, Blower-Aided Cooling	N	-	Not applicable
3.4.5.3	Thermal Detectors	Y	C	Temperature Monitors on both the FO Switch and the DMG monitor temperature and provide status faults to the TOCC when over-temperature conditions occur.
3.5.5	RED/BLACK	N	-	No classified equipment for DAS, Requirement is N/A
3.6.1	Elapsed Time Meter	Y	C	This requirement was waived under Deviation DAS-D10
3.6.2	AC Power	Y	C	FO Switch and the DMG are compatible with STDN 270.5 rack-supplied single-phase power. No line filters are used on either equipment
3.6.3	DC Power Supplies	N	-	Neither the FO Switch nor the DMG use dedicated DC power supplies
3.6.4	Electrical Interface	Y	C	All FO Switch and DMG interface connections are made using bulkhead connectors. All non-isolated connectors use shielded cables. No wye or tee connections for paralleling are used.
3.6.5	Grounding	N	-	STDN No. 270.5 takes precedence
3.6.6	Circuits	Y	C	This requirement is applicable to circuit card assemblies, all of which are purchased as COTS devices for the FO Switch. DMG circuits meets all requirements for circuits presented in section 3.6.6,
3.6.7	Components	Y	C	This requirement is applicable to circuit card components, all of which are purchased as COTS devices for the FO Switch. The DMG meets all requirements in Section 3.6.7, except the requirement for EMI type indicators. The DMG does meet the EMI requirement for DAS, however, which supersedes this specification.
3.6.8	Ancillary Equipment	N	-	DAS does not use rack-mounted monitoring equipments as described.
3.6.9	Printed Circuit Boards and Wire-Wrap Cards	Y	C	This requirement is applicable to circuit card assemblies, all of which are purcased as COTS devices for the FO Switch. The PCBs of the DMG meet all requirements in Section 3.6.9.
3.7	Cabling	Y	C	Cabling between the FO Switch/DMG and other equipment are compliant w/STDN SPEC-8 and 530-WSC-LOP-VII per the SRD. The cables are, however, compliant with this Para. as well.

STDN SPEC-4 Section No.	Requirement	Applicable to DAS1 (Y/N)	Compliant (C) or Non-compliant (N)	Comments
3.8	Connectors	N	-	STDN SPEC-8 lists specific vendors for cable components delivered to DAS. No investigation was performed to determine how these NASA requirements compare with one another.
3.9	Acoustical Noise	N	-	The FO Switch blowers are quieter than existing TGBFS fans. The DMG blower is identical to that used for the TGBFS equipment.
3.10, 3.11, 3.12	Interchangeability, Workmanship, Interface Documentation	N	-	Interchangeability and workmanship are in accordance with best commercial practices, and are equivalent to those provided under the TGBFS program.
3.13	Environmental Conditions	N	-	Environmental compliance to SRD requirements is performed by COTS component manufacturers only (0 to 70 degrees C). No additional testing is performed. No DAS SRD environmental testing requirement has been levied.
3.14	ElectroMagnetic Interference (EMI)	Y	C	SRD Requirement is met by FCC Class A testing only for both devices.
3.15	Human Engineering	Y	C	The FO Switch and DMG are human engineered using Best Commercial Practices. Controls and interconnections are easily accessible, and high voltages/moving parts are marked and protected against inadvertent contact.
3.16	Maintainability	N	-	SRD explicitly deletes this requirement.
3.17	Spare Parts	Y	C	The FO Switch and DMG have been included in evaluations made to determine sparing in the Spares and Provisioning Conference.
3.18	Installation	Y	C	Provisions for the installation of these components shall be made in the DAS Installation Plan, a separate DAS deliverable data item. Installation does not require special tools.
3.19/3.20	O&M Manual, and Training	Y	C	An O&M Manual and Training shall be provided for the FO Switch and the DMG under DAS deliverable data items.
4	Quality Assurance	Y	C	ITT AES-Reston is an ISO-9001 approved vendor
5	Preparation for Delivery	Y	C	The FO Switch and the DMG shall be prepared for delivery IAW best commercial practices.

Table 3.4-3 below provides a compliance matrix showing the compliance of the provided rack assemblies (Pentair Electronic Packaging PN E-8187-1) with the SRD Requirement for their design (STDN No. 270.5). The following list provides the STDN No. 270.5 specification section, its applicability to DAS and its compliance status.

Table 3.4-3: STDN No. 270.5 Compliance Matrix

STDN No. 275 Section No.	Requirement	Applicable to DAS[1] (Y/N)	Compliant (C) or Non-compliant (N)	Comments
1& 2	Scope and Applicable Documents	N	C	Compliant to the extent presented herein
3.1	Configuration Requirements – Covers Fabrication, Rack Size, Pontoon Base, Cooling Ducts, Side panels, Top[2], Rear Door, Vertical Mounting Rails, Horizontal Mounting Rails	Y	C	Meets all criteria
3.2.1	Structural Requirements – Rack Material	Y	C	Rack material is as called out in the specification with plating differences as denoted in ITT Deviation DAS-D01.
3.2.2	Projections	Y	C	Outside radii 0.25" max., no burrs or sharp edges
3.2.3	Screw Threads	Y	C	Screw threads are standard dimensions/types
3.2.4	Hardware	Y	C	Equipment Mounting Hardware Kit, Equipment Power Connection Hardware Kit, and Equipment Grounding Connection Hardware Kit all provided with each Rack assembly from vendor. Not all parts provided, are used, however.
3.3	Electrical Requirements 3.3.1 – RED Installation	N	N/A	DAS does not have RED/BLACK Separation requirements.
3.3.2	Power 3.3.2.1 – 3 wire Outlet	Y	C (see comments)	Power Inlet Box and power strip modified per ITT Deviation DAS-D09.
3.3.2.2	Power Outlet Strip Mounting	Y	C	Location of power outlet strip is per STDN No. 270.5
3.3.2.3, 3.3.1.4	Power Inlet Box Equipment,, Power Inlet Box Connections	Y	C (see comments)	Power Inlet Box and power strip modified per ITT Deviation DAS-D09.
3.3.3	Grounding 3.3.3.1 – Rack Configuration	Y	C	Copper ground bus bar installed and bonded to rack with tinned-copper braided conductor.
3.3.3.2	Signal Ground Terminations	Y	C	Ground bus-bar connection documented in ITT drawing 185-600089.
3.4	Protective Coatings 3.4.1 – Surface Preparation	Y	C	Visual inspection showed no surface defects or imperfections
3.4.2	Rack Surfaces	Y	C (see comments)	Modified per ITT Deviation DAS-D01 to comply with EPA, provide commercial finish method.
3.4.3	Internal Vertical Mounting Rail Surfaces	Y	C	Internal vertical mounting rails treated per STDN 270.5
3.5	Replaceable Parts List	N	C	Per RMA, DAS rack components are a single LRU and have no replaceable parts. The vendor for these racks (Pentair Electronic Enclosures) may be contacted to obtain spare parts for the assembly provided.
3.6	Environmental	Y	C	Vendor Certification
4.1	Concurrent Testing	Y	C	Vendor Certification
4.2	Vibration Test	Y	C	Vendor Certification
4.3	Resistance Test	Y	C	Vendor Certification
5	Preparation for Delivery	N	N/A	This requirement is applicable for delivery from vendor to initial installation site only.
6	Notes 6.1 – Optional Items			The following optional items were not specified in the SRD with the exception of tapped mounting rails in section 6.8. The EMC requirements for STDN 270.5 racks were not applicable to DAS because the SRD required only component compliance. The racks provided, however, supply the EMC compliance features summarized under Section No. 6.10 below.
6.2, 6.3, 6.4, 6.5, 6.6, 6.7	Cooling Ducts, Less Pontoon Base, Side Panels, Front Door, Less Rear Door, Partial Height Doors	N	N/A	
6.8	Tapped Panel Mounting Rails	Y	C	Required per SRD. Inspected and compliant.
6.9	Blank Panels	N	N/A	Supplied panels are compliant w/6.11.
6.10	Electromagnetic Compatibility (EMC)	N	C, Partial	Voluntary compliance with sections 6.10.1 through 6.10.4. Note that conductive coatings were changed IAW ITT deviation DAS-D12.

STDN No. 275 Section No.	Requirement	Applicable to DAS[1] (Y/N)	Compliant (C) or Non-compliant (N)	Comments
6.11	Blank Panels (EMC)	N	C, Partial	Voluntary compliance (not an SRD requirement, but met by DAS). Note that EMC Spacer bars are not used for DAS because there is no EMC requirement for the DAS electronic enclosures.
6.12	Spacer Frame (EMC)	N	C	Voluntary compliance
6.13	Internal Mounting Rails	N	N/A	
6.14	Rack Widths	N	N/A	
6.15	Fan-Aided Cooling	N	N/A	Top waveguide vents added to meet thermal requirements per ITT Deviation DAS-D12.
6.16	Insulated Busbar	N	N/A	
6.17	Drawings	N	N/A	Drawings provided by vendor only. Rack is a COTS product.
6.18	Rack, Console, Electronic Equipment	N	N/A	Spec.'s for 53 inch tall rack option, N/A for DAS
Notes: Not all portions of the STDN No. 270.5 spec. are applicable to DAS. In particular, requirements pertaining to RED/BLACK isolation, EMC (section 6.10) do not apply The top of the DAS racks is fitted with a honeycomb waveguide vent to provide additional cooling as provided in rack options (Section 6.15)				

3.5 INSPECTION CASE 4: EMI

3.5.1 Summary (3 Requirements)

The objective of Inspection Case 1 is to verify requirements related to EMI. Specific requirements to be verified are listed below in Table 3.5-1. As indicated in Column 7 of the table, all requirements have been successfully verified.

Table 3.5-1: Inspection Findings for Case 4 (EMI)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
316	5.4.c	The operational convenience of the DAS shall be maintained while satisfying the above requirements by the exclusion of rack front doors, hidden controls and displays, and by the location of equipment in the system racks	The configured racks shall be visually inspected with focus on operational convenience.	The inspection must show that there are no rack front doors, hidden controls and displays, and by the location of equipment in the system racks.	There are no rack front doors There are no hidden controls The DAS component layout is designed for convenience: Keyboards and monitors elevated for convenient operation from a seated position All controls and equipments are clustered near the middle of the racks to minimize operator inconvenience	Pass
317	5.4.d	EMI racks and filtering shall be used as required.	The rack data sheets and DAS system documentation shall be inspected	The inspection must show that EMI racks are used and that EMI filtering is not used (Paragraph 5.4.g is verified under Q11)	EMI racks have been used but are not a formal requirement of the SRD. EMI filtering is not used	Pass
318	5.4.e	All controls and displays shall be fully accessible during setup and normal operation of the DAS.	The configured racks shall be visually inspected with focus on controls and displays.	The inspection must show that all controls and displays are fully accessible during setup and normal operation of the DAS.	All controls and displays are fully accessible during setup and normal operation of the DAS	Pass

3.6 INSPECTION CASE 5: INSTALLATION

3.6.1 Summary (10 Requirements)

The objective of Inspection Case 1 is to verify requirements related to Installation. Specific requirements to be verified are listed below in Table 3.6-1. As indicated in Column 7 of the table, all requirements have been successfully verified, except for three requirements that are pending SAT.

Table 3.6-1: Inspection Findings for Case 5 (Installation)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
322	6.1.1.a	WSC-provided site documents shall be used in planning the configuration and layout of equipment.	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.) shall be inspected with focus on reference material used in generating the plan.	The inspection must show that WSC-provided site documents were used in planning the configuration and layout of equipment.	The DAS installation requires a thorough knowledge of the locations and interconnects of existing equipment on site. The DAS Site Preparation and Installation Plan (DRL 10) shows rack elevations, cables run lists and suggested cable routings for both DAS sites. Cable lengths and interfaces were designed based on WSC-provided site documents.	Pass
323	6.1.1.b	A set of plans shall be developed that provides an efficient layout of all equipment.	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.) shall be inspected with focus equipment layout.	The inspection must show the plan provides for an efficient layout of all equipment; this includes operator monitors that must be placed conveniently.	Inspection of the DAS layout shows that equipment is logically placed in a left-to-right flow through the DAS system. Operator monitors are placed in locations suitable for monitoring operation and close enough to equipment for easy troubleshooting of detected equipment problems.	Pass
324	6.1.1.c	The site plan shall provide drawings that specify the type, size, length, number, and layout of conductors for all signal and power cabling necessary for equipment operation	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.) shall be inspected with focus on conductor design.	The inspection must show the plan specifies the type, size, length, number, and layout of conductors for all signal and power cabling.	Type, size, length, number and layout of conductors for all signal and power cabling are provided in the Cable List submitted by CSOC for EC 8266. This list, supplemented by ITT Cable drawings and the ITT provided Site Preparation and Installation Plan, provides all required cabling information necessary to install the DAS system.	Pass
325	6.1.1.d	The site plan shall contain, for each major component: the BTUs emitted; the electrical power requirements by KVA, Hertz, Volts and power conditioning; and the floor space area occupied by each rack or multiple rack system.	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.) shall be inspected with focus on heat generated, electrical power and floor space.	The inspection must show the plan specifies for each major component: the BTUs emitted; the electrical power requirements by KVA, Hertz, Volts and power conditioning; and the floor space area.	Table 2-2 of the DAS Site Preparation and Installation Plan (DRL 10) provides the BTUs emitted, the electrical power requirements by KVA for each rack or workstation component installed for DAS. DAS components are designed to operate with the site-provided ac power as specified in STDN No. 270.5 and STDN SPEC-4. The locations and associated floor space occupied by each rack are provided in the referenced Site Preparation and Installation Plan.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
326	6.1.1.e	The equipment installation shall be documented in accordance with the requirements of the WSC Handbook Series, Volume VII, 530-WSC-LOP-VII and, the Specification Station Handbook Documentation, STDN-SPEC-10.	The DAS Installation Plan will be created with the assistance of WSGT personnel to comply with 530-WSC-LOP-VII. The DAS Installation Plan will be inspected	The DAS Installation Plan shall provide Floor Plans, Equipment Locations, Cabling Plans, Rack Elevations, and Cable Runs List using guidance from STDN-SPEC-10. The DAS Installation Plan must provide sufficient documentation in the formats presented in the referenced specifications, using TGBFS supplied documents as a guideline.	The DAS Site Preparation and Installation Plan (DRL 10) provides floor plans, equipment locations, cabling plans, and rack elevations per STDN-SPEC-10. The DAS Cable Runs List has been provided to CSOC for incorporation into the DAS EC (EC # 8266).	Pass
327	6.2.a	All power and signal cables necessary for equipment operations shall be provided.	The site prior to installation shall be inspected with respect to signal and power cables.	The inspection must show that all power and signal cables necessary for equipment operations has been provided.	Need to wait until SAT	Pending SAT
328	6.2.b	Cable installation shall be in accordance with the requirements of STDN-SPEC-6, GSFC Specification Installation Requirements for STDN Equipment	The site prior to installation shall be inspected with respect to cable installation.	The inspection must show that cables have been installed in accordance with STDN-SPEC-6, GSFC.	Need to wait until SAT	Pending SAT
329	6.2.c	All cable fabrication shall be in accordance with the requirements of STDN-SPEC-4, Section 3.7.	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.), cable drawings and the site prior to installation shall be inspected with focus on cable fabrication.	The inspection must show that cables have been fabricated in accordance with the requirements of STDN-SPEC-4, Section 3.7.	All DAS provided cables have service loops, support, and slack sufficient to meet the requirements of STDN SPEC-4. The racks provide I/O panels as provided, and all cables are shielded with the exception of COTS supplied Ethernet cables or Fiber Optic cables. Cables are routed through the bottoms of the racks, and are marked IAW 530 WSC-LOP-VII.	Pass
330	6.3.a	Equipment installations shall be in accordance with STDN-SPEC-6, Installation Requirements for STDN Equipment.	The site plan document, EC, associated documentation (rack elevations, cable run lists, etc.) and the site prior to installation shall be inspected.	The inspection must show that the installation is in accordance with the requirements STDN-SPEC-6.	The compliance of the DAS system with STDN SPEC-6 requirements is detailed in Table 3.6-2.	Pass
331	6.3.b	Floor panels shall be in accordance with the requirements of STDN-SPEC-6.	The site prior to installation shall be inspected with focus on floor panels.	The inspection must show that the floor panels are in accordance with the requirements of STDN-SPEC-6.	Need to wait until SAT	Pending SAT

The table below provides a compliance matrix showing the compliance of the DAS-provided components with the SRD Requirement that equipment installations shall be in accordance with STDN SPEC-6, Installation Requirements for STDN Equipment. The following table provides the STDN SPEC-6 specification section, its applicability to DAS and its compliance status.

Table 3.6-2: STDN SPEC-6 Compliance Matrix

STDN No. 275 Section No.	Requirement	Applicable to DAS (Y/N)	Compliant (C) or Non-compliant (N)	Comments
1& 2	Scope and Applicable Documents	N	C	Compliant to the extent presented herein
3.1, 3.1.1	Equipment Installation Rack-mounted Systems	Y	C	The CSOC generated Engineering Change (EC 8266) defines the equipment, its layout, and the required interconnect cabling for this modification. The individual equipments used for DAS functions shall be mounted within the racks (except those components on the workstation desk, or those installed in GDIS racks).
3.1.2	Racks	Y	C	Rack installation complies with 3.2.1 Sections a-e directly, and the floor louver and cable entrance holes will be made per the DAS Site Preparation and Installation Plan, Appendix C. Rack tie-downs and rack grounding will be installed per WSGT and GRGT SOP. Blank panels will be installed in unused front-panel mounting spaces.
3.1.3	Cable Hangers	N	NA	Cable hangers are site provided
3.1.4	Cable Numbering	Y	C	Cables are numbered and documented per 530-WSC-LOP-VII. This requirement incorporates all the requirements for 3.1.4 and adds guidance in requirements for labeling and cable list data.
3.1.5	RED/BLACK	N	NA	DAS will not be used for classified (RED) information
3.1.6 3.1.6.1 3.1.6.2	Cabling, Power Cables Signal Ground Cables	Y	C	DAS Inter-rack cables are constructed with approximately 6 feet of service loop at either end. All cables are checked for continuity, opens or shorts. Power cables are designed for conformance to section 3.1.6.1, but routing requirements for both power and signal grounds will be the responsibility of CSOC installers.
3.1.6.3	Signal and Control Cables	Y	C	All cabling requirements related to cable routing (paragraphs a.-f.) will be the responsibility of CSOC installers. DAS cables within the racks are neatly laced.
3.1.7	Cable Entrance Junction Box	N	NA	No connections to outside wall of facility
3.1.8	Photographic Documentation	N	NA	This is an installation requirement, beyond the scope of ITT's tasking.
3.1.9	Louver Setting	N	NA	This is an installation requirement, beyond the scope of ITT's tasking
4	Quality Assurance	N	NA	ITT AES-Reston is an ISO-9001 approved vendor
5	Preparation for Delivery	N	NA	Specification states that this section is not applicable
6	Notes	N	NA	Specification states that this section is not applicable

3.7 INSPECTION CASE 6: TRAINING

3.7.1 Summary (14 Requirements)

The objective of Inspection Case 6 is to verify requirements related to training. Specific requirements to be verified are listed below in Table 3.7-1. As indicated in Column 7 of the table, all requirements have been successfully verified.

Table 3.7-1: Inspection Findings for Case 6 (Training)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
340	8.3.a	The training program shall include a definition of the qualifications required by operations and maintenance personnel to meet position description skill requirements	The training plan and materials shall be inspected.	The inspection must show that the training program includes a definition of the qualifications required by operations and maintenance personnel.	Training Plan Section 6 provides student profiles with perquisite qualifications and experience	Pass
341	8.3.b	A training plan to define the phasing, methods and techniques for achieving the requisite skill levels, using curricula and course materials for skill/qualification areas within each position description shall be included	The training plan and materials shall be inspected.	The inspection must show that the training program defines the phasing, methods and techniques for achieving the requisite skill levels, using curricula and course materials for skill/qualification areas within each position description.	Training Plan, Section 7, describes student certification requirements for both Level 1 operations and maintenance and Level 2 maintenance skills. Section 6 describes typical student profile skills as provided by NASA, and Section 4 describes the training approach and method, which includes the focus and outline of each course.	Pass
342	8.3.c	Training devices and equipment shall be included.	NA because NASA has procured no training devices or equipment.	NA, as long as no training devices or equipment procured by NASA.	Hands-on demonstrations using the operational DAS equipment is planned to be included in the Training Courses and used at the instructors' discretion. There are no specific training devices for DAS	Pass
343	8.3.d	Administrative support to implement the training program shall be included.	The training plan and materials shall be inspected to ensure that administrative support is provided to implement the training program.	The inspection must show that the training program includes administrative support to implement the training program.	Training Plan, Sections 7.2 and 7.3, discuss Government and ITT administrative support required in conjunction with the training courses.	Pass
344	8.4.1.a	Operator training shall cover a DAS network overview.	The training plan and materials shall be inspected to include a DAS Network overview.	The inspection must show that the training program for Operators includes a DAS network overview.	Training Materials contain a DAS network overview in Training Unit 1.2/1.3	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
345	8.4.1.b	Operator training shall cover the DAS concept of operations including key design features.	The training plan and materials shall be inspected to cover CONOPS including key design features.	The inspection must show that the training program for Operators includes the DAS concept of operations including key design features.	Training Materials contain the DAS operations concepts and key features in Training Unit 2.1/2.1.1 Theory and Operations Concepts	Pass
346	8.4.1.c	Operator training shall cover detailed DAS operational procedures.	The training plan and materials shall be inspected to cover detailed DAS operational procedures.	The inspection must show that the training program for Operators includes detailed DAS operational procedures.	Detailed operator procedures will encompass 15 of 40 hours in the initial training. As shown in the course outline, concentration of the instruction will be on the use of the DASCON, DCON, ICON and ECON user screens along with ancillary operator procedures such as adding new equipment and customers, IERS updates, and daily operator housekeeping tasks	Pass
347	8.4.2.a	Maintenance training for both hardware and software shall cover DAS maintenance concept.	The training plan and materials shall be inspected to cover System Level 1 Maintenance only; there is no software maintenance.	The inspection must show that the training program for hardware maintenance includes the DAS maintenance concept.	An inspection of the DAS initial training course outline showed that unit of instruction 3.1 would describe DAS maintenance concepts. The objective of this instruction is for the student to be able to state the DAS maintenance concept in terms of equipment removal and replacement (primarily at the LRU level)	Pass
348	8.4.2.b	Maintenance training for both hardware and software shall cover diagnostics and troubleshooting.	The training plan and materials shall be inspected relative to System Level 1 Maintenance only; there is no software maintenance.	The inspection must show that the training program for hardware maintenance includes diagnostics and troubleshooting.	An inspection of the Training Course outline showed that units 3.5.6 and 3.5.7 will describe Troubleshooting and LRU fault isolation procedures and diagnostic testing, respectively.	Pass
349	8.4.2.c	Maintenance training for both hardware and software shall cover detailed repair procedures and techniques including the use of available tools and repair equipment	The training plan and materials shall be inspected relative to System Level 1 Maintenance only; there is no software maintenance.	The inspection must show that the training program for hardware maintenance includes detailed repair procedures and techniques including the use of available tools and repair equipment.	An inspection of the Level 2 maintenance course for the DMG showed that detailed repair procedures would be taught in unit 2.3.4. Detailed repair procedures are not taught as part of the Level 1 basic O&M training course.	Pass
350	8.4.2.d	Maintenance training for both hardware and software shall cover DAS software maintenance concepts.	The training plan and materials shall be inspected relative to System Level 1 Maintenance only; there is no software maintenance.	The inspection must show that Maintenance training will provide SW maintenance concepts training.	An inspection of the Training Course outline showed that DAS software maintenance concepts would be taught in unit 3.1 of the basic course and in units 1.3 and 1.4 of the DMG maintenance course and in units 7.1 and 7.2 of the Level 2 software maintenance course.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
352	8.4.2.f	Training shall cover maintenance of both operational and support software.	The training plan and materials shall be inspected relative to System Level 1 Maintenance only; there is no software maintenance	The inspection must show that the training program includes maintenance of both operational and support software.	An inspection of the Training Course outline showed that maintenance of both operational and support software .would be taught in unit 3.1 of the basic course and in units 1.3 and 1.4 of the DMG maintenance course and in units 7.1 and 7.2 of the Level 2 software maintenance course.	Pass
353	8.5.a	DAS training devices and equipment for maintenance training shall be specified in the Training Plan.	The training plan and materials shall be inspected. However this is NA because NASA has procured no training devices or equipment.	NA, as long as no training devices or equipment procured by NASA.	NA, there are no training devices for DAS training other than the operational equipment when it is accessible.	Pass
354	8.6.a	Administrative support for training shall provide for the testing and certification of students.	The training plan and materials shall be inspected to show that students are tested.	The inspection must show that administrative support for training provides for the testing and certification of students.	Training Plan, Section 7, describes government and ITT responsibilities for student certification	Pass

3.8 INSPECTION CASE 7: SPARING

3.8.1 Summary (8 Requirements)

The objective of Inspection Case 7 is to verify requirements related to sparing. Specific requirements to be verified are listed below in Table 3.8-1. As indicated in Column 7 of the table, all requirements have been successfully verified, except for two requirements that are pending SAT.

Table: 3.8-1: Inspection Findings for Case 7 (sparing)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
369	10.1.a	Spares provisioning for the WSC shall be determined and provided by the development contractor through Provisional Acceptance Testing	The ILSP shall be inspected.	The inspection must show that the Development Contractor provides spares for WSC through SAT.	Need to wait until SAT	Pending SAT

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
370	10.1.b	A series of provisioning conferences shall be supported to develop the spares provisioning program in accordance with STDN 507, Network Logistics Manual	The agenda, meeting materials and minutes of the provisioning conferences shall be inspected.	The inspection must show that the contractor supported the conferences for the Spares Provisioning program in accordance with STDN 507, Network Logistics Manual.	ITT's role in supporting the sparing conference and provisioning was to develop spares lists in support of the provisioning conference. The government role was to decide what spares should be on the lists and determine a reasonable budget for spares support.	Pass
371	10.1.c	All support spares remaining after Acceptance testing shall be delivered to the WSC site.	The spares delivered to the WSC site after SAT will be inspected.	The inspection must show that all support spares remaining after Acceptance Testing are delivered to the WSC site.	Need to wait until SAT	Pending SAT
372	10.1.d	The information required to develop, implement and maintain operation of this spares provisioning program, consistent with the DAS requirements contained in this Specification and the spares provisioning requirements identified in the following sections	The ILSP reports will be inspected.	The inspection must show that the ILSP contains all the information to successfully develop, implement and maintain operation of the Spares Provisioning program	By virtue of complying with the Sparing requirements in the DAS SRD and the approval of the ILSP by NASA, ITT has shown that successful operation of the Spares Provisioning Program has been met.	Pass
373	10.3.a	The initial spares provisioning shall be determined. A spares provisioning formula will not be provided by NASA.	The RMA and ILSP reports will be inspected to show that initial spares provisioning lists have been developed.	The inspection must show that the reports contain the recommended sparing list.	In examining Section 5.2 of the ILSP, Tables 5.2 and 5.3 provided an initial recommended spares list and a final spares list based on the LRUs for each component subsystem within DAS.	Pass
374	10.3.b	The proposed spare parts and quantities shall be based upon satisfying the availability and maintainability requirements of this Specification	The RMA and ILSP reports will be inspected.	The inspection must show that the recommended spare parts are consistent with the availability requirements in the SRD.	ILSP Section 5.1 provides the method for spares determination on the DAS program. The determination was based on availability and maintainability statistics in the following way: Sparing quantities and locations were determined by reviewing the DAS RMA Initial Prediction for failure rates and repair times, and by considering similar systems currently in field use. Factors considered in evaluating spares quantities and locations include: Mean Time Between Failure (MTBF) and Mean Time to Repair (MTTR) for each LRU, Level 2 repair times from similar	Pass

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Inspection Findings	Pass or Fail
					systems, the number of times any particular LRU can be repaired, cost effectiveness, and location.	
375	10.4.1.a	It shall be ensured that either spare parts are available for a period of 10 years after Final Acceptance Testing or that NASA be provided advance notice of intent to discontinue manufacture of parts/components by all levels of subcontractors	The RMA and ILSP reports will be inspected.	The inspection must show that the analysis for Spares Provisioning was based on a 10 year life.	ILSP Section 5.1 showed that the DAS spares quantity was determined based on the following formula: $Q_S = Q_{LRU} * \left(\frac{43{,}800}{MTBF} - 1 \right)$ The 43,800 hours was used in the calculation based on a 10-year or 87,600 hour life cycle and the ability to repair an LRU 2 times before disposal hence 87600/2 = 43,800	Pass
376	10.4.a	Technical data shall be provided to allow for procurement of spare parts directly from the actual manufacturer of the equipment	The RMA and ILSP reports will be inspected.	The inspection must show that the Plan contains technical data to allow for procurement of spare parts directly from the actual manufacturer of the equipment.	ILSP, Section 6 contains DAS requirements for technical data and documentation (TD&D), which includes equipment specs O&M Manuals equipment manufacturer/vendor training documentation, source code and engineering drawings. With these documents, equipments parts lists and manufacturers are provided so that the government could procure spares.	Pass

3.9 INSPECTION CASE 8: SECURITY

3.9.1 Summary (6 Requirements)

The objective of Inspection Case 8 is to verify requirements related to security. Specific requirements to be verified are listed in Table 3.9-1. As indicated in Column 7 of the table, all 6 requirements are pending SAT.

Table 3.9-1: Inspection Findings for Case 8 (Security)

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Inspection Findings	Pass or Fail
378	11.2.a	The DAS IT Security Boundary for Customer control and status shall be at the interface to the SWSI. SWSI security implementation is documented in 452-SP-SWSI, Security Plan for	The inspection will examine the installation for conformance with the DAS-SWSI ICD. DAS installation has no SWSI interfaces except the DAS-NISN interface at the	The inspection must show that DAS installation complies with the DAS-NISN interface portion of 453-ICD-DAS/SWSI.	Need to wait until Installation is complete	Pending SAT

1	2	3	4	5	6	7
Req ID	SRD Sec. #	SRD Requirement	Verification Approach Description	Success Criteria	Inspection Findings	Pass or Fail
		SWSI.	Smart Hub.			
379	11.2.b	The DAS IT Security Boundary for NISN Closed IONet telemetry delivery shall be at the WSC Closed IONet interface. NISN Closed IONet security implementation is documented in 290-003, IP Operational Network (IONet) Security Plan.	The inspection will examine the installation for compliance	The inspection must show that DAS installation has no NISN interface except the DAS-NISN interface at the Smart Hub. DAS approved for Operational processing.	Need to wait until Installation is complete	Pending SAT
380	11.2.c	The DAS IT Security Boundary for Internet telemetry delivery shall be at the interface with the NISN Secure Gateway defined in 290-003, IP Operational Network (IONet) Security Plan.	The inspection will examine the installation for compliance	The inspection must show that DAS installation has no NISN interface except the DAS-NISN interface at the Smart Hub. DAS approved for Operational processing.	Need to wait until Installation is complete	Pending SAT
381	11.2.d	The DAS Physical Security Boundary shall be within the Category II Limited Areas defined in MO&DSD 530-WSC-0009, WSC Security Manual	The inspection will examine the installation for compliance	The inspection must show that DAS is actually installed within the physical boundaries established in the installation plan.	Need to wait until Installation is complete	Pending SAT
382	11.3.a	The DAS connection to the SWSI interface shall be via the Closed IONet only.	The inspection will examine the installation for compliance	The inspection must show that DAS installation has no SWSI interfaces except the DAS-NISN interface at the Smart Hub.	Need to wait until Installation is complete	Pending SAT
383	11.3.b	The DAS connection to the NISN Secure Gateway shall be via the Closed IONet only.	The inspection will examine the installation for compliance	The inspection must show that DAS installation has no NISN interfaces except the DAS-NISN interface at the Smart Hub.	Need to wait until Installation is complete	Pending SAT

3.10 INSPECTION CASE 9: PTP PROCESSING AND ROUTING

3.10.1 Summary (11 Requirements)

The objective of Inspection Case 9 is to verify requirements related to PTP processing and routing. Specific requirements to be verified are listed in Table 3.10-1. As indicated in Column 7 of the table, all requirements have been successfully verified.

Table 3.10-1: Inspection Findings for Case 9 (PTP Processing and Routing)

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
77	3.1.5.1.1.b	The DAS shall support Consultative Committee for Space Network Data Systems (CCSDS) formatted return data as implemented in the WSC Transmission Control Protocol (TCP)/Internet Protocol (IP) Data Interface Services Capability (WDISC).	The inspection will compare the PTP documentation provided by AVTEC with available WDISC documentation.	The inspection must show that the DAS PTP can perform WDISC equivalent formatting of return data.	A comparison of References [16] and [17] to AVTEC TM 98-05-01 provided by WSC indicates that the DAS PTPs are capable of supporting all return data formats supported by WDISC. Note that while WDISC requires users to separately schedule time on the WDISC PTPs to manually configure and manipulate the PTP service, DAS provides fully automated scheduling and alignment of the PTP services in accordance with 453-ICD-DAS-Customer Interface Control Document with single request and without manual control of the PTP desktop.	Pass
146	3.1.9.c	The DAS implementation shall provide for modular expandability for archiving Customer data.	The COTS PTP design documentation, O&M Manuals, and Data Sheets will be reviewed to determine that a second PTP can be added to both GRGT and WSGT	The inspection must show that DAS can accommodate a second PTP at both GTGT and WSGT.	(See Paragraph 3.10.2 for additional details). Modular Expandability requires additional PTPs, which in turn requires changes in both DAS HW and SW. Paragraph 3.10.2 identifies the required HW/SW changes and shows that these changes can be accommodated with the current DAS design and implementation. It is also noted Modular Expandability in archiving may also be achieved in the future by replacing the PTP user data storage raid mirrored 72 GB drives with larger drives when they become available.	Pass
147	3.1.9.d	The DAS implementation shall provide for modular expandability for routing Customer data	This is interpreted to mean routing for the 'Local Interface' since the normal data routing to users is via a single TCP port using IP addressing. The COTS NISN router/hub design documentation, O&M Manuals, and Data Sheets will be assessed to determine the number of ports that are available for 'Local Interface' support.	The inspection must that multiple ports are available for additional data routing and that it is expandable if required.	The CISCO 2912XL Ethernet Smart Data hub has 12 10/100BaseT data ports without auto-speed sensing. Two ports are assigned for WSGT PTP inputs, one to the GRGT router input, one to the DAS to NISN output. Eight ports are available to the WSGT local interface; one is required. Should additional local ports be needed a supplemental hub external to DAS can be added. See 076-6000122 for programming the Smart Data Hub connections.	Pass
148	3.1.9.e	The DAS implementation shall provide for modular expandability for	This is interpreted to mean "data formatting" processing since the other	The inspection must show that DAS can accommodate a second PTP at both GTGT and WSGT	(See Paragraph 3.10.2 for additional details). Modular Expandability requires additional PTPs, which in turn requires changes in both DAS HW and SW. Paragraph 3.10.2	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
		processing function	subparagraphs of 3.1.9 cover the other DAS elements. The COTS PTP design documentation, O&M Manuals, and Data Sheets will be reviewed to determine that a second PTP can be added to both GRGT and WSGT		identifies the required HW/SW changes and shows that these changes can be accommodated with the current DAS design and implementation. It is also noted Modular Expandability in archiving may also be achieved in the future by updating the PTP software as AVTEC adds additional functionality.	
149	3.1.9.f	The DAS shall provide for modular expandability for upgrades to support future CCSDS compatible telemetry formats	The COTS PTP design documentation, O&M Manuals, and Data Sheets will be analyzed to determine that the PTP can be upgraded to support CCSDS compatible telemetry formats.	The inspection must show that upgrades to support CCSDS processing are available and feasible.	The DAS PTPs are software driven. Per reference (c), Section 1, each PTP is limited to 25 desktops (return data processing streams) using 32 processing modules. No desktop uses more than 12 modules. Additional CCSDS formats can be accommodated by: 1. Upgrading the COTS PTP software to incorporate new modules. (An upgrade service is supported under the PTP Extended Maintenance Option.) 2. Upgrading the DAS DASCON SWSI interface, database, LCM GUI and PTP interface software to invoke the new formats 3. Upgrading the SWSI software to offer the customers the choice to use the new formats.	Pass
259	3.2.5.1.1.b	The DAS shall support frame sync based CCSDS protocol for routing data to Customers via Closed IONet or dedicated Customer circuits	The COTS PTP documentation will be inspected.	The inspection must show that the PTP supports frame sync based CCSDS protocol for routing data.	Reference [16], Page 1 defines the PTP Super Synchronizer Module. DAS invokes this module to frame all CCSDS frame-based protocols.	Pass
261	3.2.5.1.1.d	The DAS shall support the IP Data Unit (IPDU) ground transport header for return CCSDS telemetry formats for routing data to Customers	The COTS PTP documentation will be inspected.	The inspection must show that the PTP supports IP Data Unit (IPDU) ground transport header for return CCSDS telemetry formats.	Reference [17], Page 4-221 defines the PTP IPDU Formatter Module. DAS invokes this module to provide the ground transport header for customers requesting IPDU encapsulation service.	Pass
262	3.2.5.1.1.e	The DAS shall support the Advanced Composition Explorer (ACE) Standard Formatted Data Unit (SFDU) ground transport header for return CCSDS telemetry	The COTS PTP documentation will be inspected.	The inspection must show that the PTP supports the Advanced Composition Explorer (ACE) Standard Formatted Data Unit (SFDU) ground transport header for return CCSDS telemetry formats.	Reference [17], Page 4-11 defines the PTP ACE Standard Formatted Data Unit Module. DAS invokes this module to provide the ground transport header for customers requesting ACE SFDU encapsulation service.	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
		formats for routing data to Customers via Closed IONet and dedicated Customer circuits.				
263	3.2.5.1.1.f	The DAS shall support the Advanced X-ray Astrophysics Facility-Imaging (AXAF-1) SFDU ground transport header for return CCSDS telemetry formats for routing data to Customers via Closed IONet and dedicated Customer circuits.	The COTS PTP documentation will be inspected.	The inspection must show that the PTP supports the Advanced X-ray Astrophysics Facility-Imaging (AXAF-1) SFDU ground transport header for return CCSDS telemetry formats.	Reference [17], Page 4-59 defines the PTP AXAF-I Standard Formatted Data Unit Module. DAS invokes this module to provide the ground transport header for customers requesting AXAF-I SFDU encapsulation service.	Pass
264	3.2.5.1.1.g	The DAS shall support the Low Earth Orbiting-Terminal (LEO-T) ground transport header for return CCSDS telemetry formats for routing data to Customers via Closed IONet and dedicated Customer circuits	The COTS PTP documentation will be inspected.	The inspection must show that the PTP supports the Low Earth Orbiting-Terminal (LEO-T) ground transport header for return CCSDS telemetry formats.	Reference [17], Page 4-245 defines the PTP LEO-T Telemetry Frame Delivery Header Module. DAS invokes this module to provide the ground transport header for customers requesting LEO-T encapsulation service.	Pass
270	3.2.5.2.1.b	The DAS shall simultaneously manage archiving up to 50 return data streams.	DAS will demonstrate simultaneous archiving from 8 DMUs in 1 DMG and collect performance parameters of the PTP. Each DMG is independent of any other DMG and using the Ethernet Switch insures network isolation between each DMG and the PTP. Therefore the only performance bottleneck is to determine how many desktops can be run simultaneously on a single PTP. By scaling and extrapolation of the	The inspection must show that DAS can simultaneously manage archiving up to 50 return data streams.	Reference [18], Section 3, Functional Tests, and Section 4, Operational Tests demonstrate that each DAS PTP can support archiving 25 simultaneous return data streams. With the two PTPs currently installed in the system, DAS can support archiving 50 streams. Inspection of the test logs provided by AVTEC reveals that each PTP will support 25 simultaneous 150 kbps users requiring frame synchronization, VCP 1 processing and Reed Solomon decoding. (See test results log files provided separately.)	Pass

1	2	3	4	5	6	7
Req ID	**SRD Sec. #**	**SRD Requirement**	**Verification Approach Description**	**Success Criteria**	**Inspection Findings**	**Pass or Fail**
			collected performance parameters for 8 data streams and some overhead, the inspection will show that a single PTP can handle 25 data streams and therefore 2 PTPs can handle 50 data streams.			

3.10.2 Additional Details for SRD #146 and #148 (Expandability)

Modular expandability of both the archiving function and the processing function requires additional PTPs. To implement this requires the following:

a. The DASCON PTP IF SW must support four PTPs:
Inspection of the DASCON PTP IF code shows that it does.

b. The DAS Frequency and Timing system must support IRIG-B inputs to the additional PTPs:
A DATUM 6504 distribution amplifier is required at WSGT to support the second PTP when it is installed as noted in the DAS CDR [19], Pages 8-41 and 8-42. This device is not needed at GRGT to add the second PTP as there is no DASCON at GRGT and therefore a spare IRIG-B tap is available on the modified Brandywine GPS80J IRIG-G to IRIG-B converter, again shown on page 8-41 of the CDR package.

c. The Smart Data Hub at WSGT must support two PTP inputs:
Inspection of the CISCO 2912XL switch used for WSGT Smart Data Hub show that it has 12 10/100BaseT fixed auto-sensing ports. Two are required to support the potential complement of PTPs; one is required to support the GDIS interface; one is required to support the DAS-NISN connection; eight are available to support potential local interfaces. Examination of the programming instructions for this switch (drawing 076-6000122) shows that it supports two PTPs, the GDIS and NISN interfaces and programs six of the available eight local interfaces.

d. The PTP to GDIS data hub at GRGT must support two PTP inputs:
Inspection of the 3COM 3C16440-US SuperStack II Hub used for the PTP to GDIS data hub at GRGT shows it has 12 10BaseT Ethernet ports. Two are required to support the potential complement of PTPs; one is required to support the GDIS interconnection. This device is not programmed.

e. The DMG-PTP hub at both WSGT and GRGT must provide outputs to two PTPs each:
Inspection of the CISCO 1924-EN Switches used as the DMG to PTP data switches at both WSGT and GRGT shows they have 24 switched 10BaseT ports. Eight are required to support the potential complement of DMGs; two are required to support potential complement of PTPs. These switches auto-sense connected IP addresses and require no programming.

f. The DAS internal IP addressing schema must support two PTPs at each site:
Inspection of the internal IP addressing schema proposed to the WSC O&M contractor indicates IP addresses for two PTPs at each site have been proposed.

g. The DAS external IP addressing schema must show two PTPs at each site:
   Inspection of the DAS-Customer ICD shows that external IP addresses for two PTPs are included.

Modular expandability in archiving may also be achieved in the future by replacing the PTP user data storage raid mirrored 72 GB drives with larger drives when they become available.

Modular expandability in data processing may also be achieved by updating the PTP software as AVTEC adds additional functionality. However, this will require the DASCON PTP interface control software to be updated in order to program the PTP desktops and both the DAS SWSI interface control software and the SWSI client software to be updated to permit the customer to use the additional processing functionality. Changes to other elements of the DASCON software and SWSI server software may be needed depending on the nature of the change.

3.11 INSPECTION CASE 10: WSC I/F (AT THE FACTORY)

3.11.1 Summary (1 Requirement)

The objective of Inspection Case 10 is to verify requirements related to WSC I/F at the Factory as listed in Qual Test Q13 (Exhibit 7-53 in DRL-14, Volume IIB). Specific requirements to be verified, inspection approach and inspection findings are detailed below in Table 3.11-1. As seen in Column 7 of Table 3.11-1, there are 23 items (I10-1 to I10-23) from Q13 that are verified here in I10.

As indicated in Column 11 of Table 3.11-1 18 requirements have been successfully verified; 46 requirements will be verified during FAT, and 36 requirements are considered “NA”.

Table 3.11-1: Inspection Findings for I10 (@Factory) and I11 (@Site)

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
3.01	S/D	4.2.1 Interface Types		2 Types of Data; 4 sets at WSC	Q4.4 E, E4			Q4.4 will demo that DAS handles two types of data (ELD and CDB) Site inspection will verify that there are 4 sets at WSC, one from each of 4 SGLTs	Pending FAT	
3.02	S/D			2 Types of Data; 1 set at GRGT	Q4.4 E1, E4			Q4.4 will demo that DAS handles two types of data (ELD and CDB) Site inspection will verify that there is one set at GRGT	Pending FAT	
3.03	S/D	4.2.2 Element Data	4.2.2.1 Points of Demarcation	SGLT-1/2				Site inspection will verify that the correct demarcation points at the Distribution Switch Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
3.04	S/D			SGLT-4/5				Site inspection will verify that the correct demarcation points at the Distribution Switch Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
3.05	S/D			SGLT-6				Site inspection will verify that the correct demarcation points at the Distribution Switch Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
3.06	D		4.2.2.2 Signal Characteristi	Port Cables				Inspection will verify that the optical cables are part of DAS	ITT to provide all ITT deliverable DAS cables based on EC 8266	Pass

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
3.07	D		cs	Cables connected to demarcation point				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
3.08	D			Optic Port Cable Characteristics				Inspection of data sheets for the COTS optical cables will verify that the characteristics in Table 4-4 are achieved	ITT PN 085-600049 cables comply w/Table 4-4 Req.'s of DAS/WSC ICD.	Pass
3.09	S		4.2.2.3 Signal Data Format	FC-PH Layer 0				NA	NA	NA
	S			FC Layer 2				NA	NA	NA
	S		4.2.2.4 Frame Format	8B/10B Encoding				NA	NA	NA
	S		4.2.2.5 Signal Bandwidth	1.0625 Gbps				NA	NA	NA
	S		4.2.2.6 Channel Assignment	5 groups of 6				NA	NA	NA
	S		4.2.2.7 Timing Skew	< 1.5 µsec				NA	NA	NA
	S	4.2.3 CDB	4.2.3.1 Contents	Beamforming Data				NA	NA	NA
	S			Synch command				NA	NA	NA
	S		4.2.3.2 Protocol	UDP				NA	NA	NA
	S		4.2.3.3 Periodicity	Beamforming Data				NA	NA	NA
	S			Synch command				NA	NA	NA
	S		4.2.3.4 Message Format	Beamforming Data				NA	NA	NA
	S			Synch command				NA	NA	NA
	S		4.2.3.5 Physic	10BaseT				NA	NA	NA

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	ICD Subsection	Reqmt	Test Sub-Case # Event #	Inspect Case I10-#	Inspect Case I11-# (@ Site)	Inspection Approach/ Success Criteria	Inspection Findings	Pass or Fail
	S		al Interface	RJ-45				NA	NA	NA
	S			Pin-out				NA	NA	NA
	D		4.2.3.6 Points of Demarcation	SGLT-1				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
	D			SGLT-2				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
	D			SGLT-4				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
	D			SGLT-5				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
	D			SGLT-6				Site inspection will verify that DAS is connected to the proper port number	Pending FAT	
	S/D	4.3.1 Message Types		TDRS SV	Q1.3 E17			NA	NA	NA
	S/D			SN Ops Data	Q1.3 E17			NA	NA	NA
	S/D	4.3.2 Message Protocol		TCP/IP				Inspection of both the ECON and DASCON SDDs will verify that DASCON uses this protocol	Both of the documents reference the TCP/IP Interface, both devices use this interface.	Pass
	S/D			Message Type				Inspection of both the ECON and DASCON SDDs will verify that the message type is part of the header information	Both of these documents specify that the message type is part of the header information.	Pass
	D	4.3.3 Periodicity	4.3.3.1 TDRS SV	Immediate Transmission	Q10 E1			NA	NA	NA
	-			Deleted				NA	NA	NA
	S/D			DASCON LCM	Q1.3 E20-E22			NA	NA	NA
	S		4.3.3.2 SN Ops Data	1 sec intervals	Q1.3 E17			NA	NA	NA

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S/D	4.3.4 Message Formats	4.3.4.1 TDRS SV	Table 4-10				Inspection of both the ECON and DASCON SDDs will verify that the TDRS SV message is constructed as required by Table 4-10	These documents do not explicitly address message construction, but DASCON SDD provides correct variables in a list, ECON SDD explicitly references Table 4-10.	Pass
	S/D		4.3.4.2 SN Ops Data	Table 4-11				Inspection of both the ECON and DASCON SDDs will verify that the SN Ops Status message is constructed as required by Table 4-11	These documents do not explicitly address message construction, but DASCON SDD provides correct variables in a list, ECON SDD explicitly references Table 4-11.	Pass
	S/D	4.3.5 Physical Interface		10BaseT				Inspection of both the ECON and DASCON HDDs will verify that 10BaseT is used	This I/F is explicitly defined in the DAS Internal ICD.	Pass
	S			RJ-45				Site inspection will verify that the WSC source is a RJ-45 modular jack	Pending FAT	
	S/D			Pin-out				Inspection of both the ECON and DASCON HDDs will verify that the pin-out is as specified in Table 4-12	Pinout is explicitly defined in DAS Wiring Diagram and ITT Drwg. 087-600037.	Pass
	S/D	4.3.6 Points of Demarcation		SGLT-1				Site inspection will verify that the demarcation points are as specified in Table 4-13	Pending FAT	
	S/D			SGLT-2				Site inspection will verify that the demarcation points are as specified in Table 4-13	Pending FAT	
	S/D			SGLT-4				Site inspection will verify that the demarcation points are as specified in Table 4-13	Pending FAT	
	S/D			SGLT-5				Site inspection will verify that the demarcation points are as specified in Table 4-13	Pending FAT	

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S/D			SGLT-6				Site inspection will verify that the demarcation points are as specified in Table 4-13	Pending FAT	
	S	4.4.1 Message Content	4.4.1.1 Status Request	From CTFS SSC to DAS	Q8 E1-E8			NA	NA	NA
	S/D			Format (Table 4-14)				Inspection of the DASCON SDD will verify the format that DAS is processing	DASCON SDD references the subject Table.	
	D		4.4.1.2 Status Response	From DAS to CTFS SSC	Q8 E1-E8			NA	NA	NA
	D			Format (Table 4-15)				Inspection of the DASCON SDD will verify the format	DASCON SDD references the subject Table.	
	D			Response Time	Q8 E1			NA	NA	NA
	S/D	4.4.2 Protocol		Table 4-16				Inspection of the DASCON SDD will verify the protocol	DASCON SDD references the subject Table.	
	S	4.4.3 Periodicity		Once per second	Q8 E1			NA	NA	NA
	S/D	4.4.4 Physical I/F		RS-422				Site inspection will verify this physical interface requirement	Pending FAT	
	S			WSC Receptacle Type				Site inspection will verify this physical interface requirement	Pending FAT	
	D			DAS Cable				Inspection of the DASCON HDD will verify that the cable/connector	cable/connector required match ITT drawing 087-600139.	
	S/D			Pin Assignment (Table 4-17)				Inspection of the DASCON HDD will verify that the pin-out is as specified in Table 4-17	Pinout is explicitly defined in DAS Wiring Diagram and ITT drawing 087-600139.	Pass
	S/D			Signal Loop Backs				Site inspection will verify this physical interface requirement	Pending FAT	
	S/D	4.4.5 Points of Demarcation		Table 4-18				Site inspection will verify that the demarcation points are as specified in Table 4-18	Pending FAT	

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S/D	4.5.1 Frequency		Quantity	Q4.2 E15			Qual testing will show that DAS supports redundant frequency inputs with automatic failover Site inspection will verify that WSC provides two frequency reference inputs to DAS at each site	Pending FAT	
	S			Characteristics (Table 4-19)				NA	NA	NA
	S/D			Demarcation (Table 4-20)				Site inspection will verify that the demarcation points are as specified in Table 4-20	Pending FAT	
	S/D	4.5.2 Time		Quantity	Q4.2 E16			Qual testing will show that DAS uses a single IRIG-G input Site inspection will verify that WSC provides one IRIG-G time reference input to DAS at each site	Pending FAT	
	S			Accuracy				NA	NA	NA
	S			Characteristics (Table 4-21)				NA	NA	NA
	S/D			Demarcation (Table 4-22)				Site inspection will verify that the demarcation points are as specified in Table 4-22	Pending FAT	
	S/D	4.5.3 1 pps		Quantity	Q4.2 E17			Qual testing will show that DAS uses a single 1 pps input Site inspection will verify that WSC provides one 1 pps input to DAS at each site	Pending FAT	
	S			Accuracy				NA	NA	NA
	S			Characteristics (Table 4-23)				NA	NA	NA

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S/D			Demarcation (Table 4-24)				Site inspection will verify that the demarcation points are as specified in Table 4-24	Pending FAT	
	S/D	4.6.1 WSGT GDIS to DAS	4.6.1.1 Demarcation	Demarcation				Site inspection will verify that the demarcation points are as specified	Pending FAT	
	S/D		4.6.1.2 Physical	RS-422/449				Inspection of the DASCON HDD will verify this physical interface requirement	Physical Interface req. met by CISCO router I/F (serial connect)	Pass
	D			Device Configuration				Inspection of the DASCON HDD will verify this physical interface requirement	Configured as DTE by default. See also router description (ITT dwg. # 002-600136)	Pass
	S/D			Three Lug TRB connectors				Inspection of the DASCON HDD will verify this physical interface requirement	Trompeter Twinax cable connectors per ITT dwg. 087-600116	Pass
	S/D			Signal names/ locations				Site inspection will verify these physical interface requirements	Pending FAT	
	S		4.6.1.3 Port Configuration	Input Port (Table 4-26)				Site inspection will verify these port assignments	Pending FAT	
	S			Output Port (Table 4-27)				Site inspection will verify these port assignments	Pending FAT	
	S/D	4.6.2 GRGT GDIS -DAS I/F	4.6.2.1 Demarcation	Demarcation				Site inspection will verify that the demarcation points are as specified	Pending FAT	
	S/D		4.6.2.2 Physical	RS-422/449				Inspection of the DASCON HDD will verify this physical interface requirement	Physical Interface req. met by CISCO router I/F (serial connect)	Pass
	D			Device Configuration				Inspection of the DASCON HDD will verify this physical interface requirement	Configured as DTE by default. See also router description (ITT dwg. # 002-600136)	Pass
	D			Three Lug TRB connectors				Inspection of the DASCON HDD will verify this physical interface requirement	Trompeter Twinax cable connectors per ITT dwg. 087-600116	Pass
	S/D			Signal names/ locations				Site inspection will verify these physical interface requirements	Pending FAT	

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S		4.6.2.3 Port Configuration	Input Port (Table 4-28)				Site inspection will verify these port assignments	Pending FAT	
	S			Output Port (Table 4-29)				Site inspection will verify these port assignments	Pending FAT	
	S/D	4.7.1 Demarcation		Demarcation (Table 4-32)				Site inspection will verify that the demarcation points are as specified	Pending FAT	
	S	4.7.2 Circuits	4.7.2.1 WSGT	Number				Site inspection will verify this requirement	Pending FAT	
	S			Size				Site inspection will verify this requirement	Pending FAT	
	S		4.7.2.2 GRGT	Number				Site inspection will verify this requirement	Pending FAT	
	S			Size				Site inspection will verify this requirement	Pending FAT	
	S	4.7.3 Characteristics		Voltage				NA	NA	NA
	S			Frequency				NA	NA	NA
	S	4.7.4 Circuit Breakers		Part of WSC				Site inspection will verify this requirement	Pending FAT	
	S/D	A.1 Demarcation		EXEC ADPE /ECON				Site inspection will verify that the demarcation points are as specified	Pending FAT	
	S/D			Rack designators				Site inspection will verify that the demarcation points are as specified	Pending FAT	
	S/D	A.2 SV Message Formats		Table A-3				Inspection of the ECON SDD will verify the format	ECON SDD references the subject Table.	Pass
	S/D	A.3 Protocol		Protocol				Inspection of the ECON SDD will verify the protocol	ECON SDD references the subject Table.	Pass
	S/D	A.4 Coordinate System		Frame of Reference				Inspection of the ECON SDD will verify the coordinate frame of reference	ECON SDD references the subject Table.	Pass
	S	A.5 Message Frequency		Initiated by Exec ADPE	Q10 E4			NA	NA	NA
	S			Initiated by the TOCC	Q10 E1-E3			NA	NA	NA

1	2	3	4	5	6	7	8	9	10	11
		ICD Section	**ICD Subsection**	**Reqmt**	**Test Sub-Case # Event #**	**Inspect Case I10-#**	**Inspect Case I11-# (@ Site)**	**Inspection Approach/ Success Criteria**	**Inspection Findings**	**Pass or Fail**
	S/D	A.6 Physical/Electrical I/F		RS-232				Inspection of the DASCON HDD will verify this physical interface requirement	This interface will be installed by CSOC under EC8266 and is not an ITT requirement.	NA
	S			DB25M				Site inspection will verify this connector type on the Exec ADPE	Pending FAT	
	S			ADPE configuration				Site inspection (including inspection of Design Documentation) will verify that the ADPE is configured as a DTE device	Pending FAT	
	S			Fiber Modem				Site inspection will verify that a fiber extenders modem is used	Pending FAT	

3.12 INSPECTION CASE 11: WSC I/F (AT THE SITE)

3.12.1 Summary (1 Requirement)

The objective of Inspection Case 11 is to verify requirements related to WSC I/F at the Site as listed in Qual Test Q13 (Exhibit 7-53 in DRL-14, Volume IIB). Specific requirements to be verified, inspection approach and inspection findings are detailed above in Table 3.11-1. As seen in Column 8 of Table 3.11-1, there are 46 items (I11-1 to I11-46) from Q13 that are verified here in I11. All requirement items are pending FAT.

4. SUMMARY OF DISCREPANCIES AND PENDING REQUIREMENTS

4.1 LIST OF DISCREPANCIES

Table 4.1-1: Summary of Discrepancies

SRD Req ID	DAS Spec Para.	Requirement	Case	A&I Report Section	Discrepancy Findings	Resolution Approach/ Status

4.1.1.1 List of Requirements Pending SAT

Table 4.1-2: Summary of Requirements Pending SAT

SRD Req ID	DAS Spec Para.	Requirement	Case	A&I Report Section	Verification Approach	Resolution Status
313	5.3.b	All cabling between DAS delivered systems and subsystems and WSC Systems shall be provided.	Design & Construction I3	3.4.1	All cabling and connectors shall be visually accounted for and checked against all the physical requirements stated in all DAS External ICDs	Pending SAT
314	5.3.c	All mating connectors shall be supplied.	Design & Construction I3	3.4.1	All mating connectors shall be visually accounted for and checked against all the physical requirements stated in all DAS External ICDs	Pending SAT
315	5.3.d	All cabling required to configure the systems and subsystems for checkout and in-plant testing shall be provided. This includes cabling required at the WSGT/STGT and GRGT sites for all special test equipment	Design & Construction I3	3.4.1	All cabling required to configure the systems and subsystems for checkout and in-plant testing shall be visually accounted for and checked against installation and test procedures	Pending SAT
327	6.2.a	All power and signal cables necessary for equipment operations shall be provided.	Installation I5	3.6.1	The site prior to installation shall be inspected with respect to signal and power cables.	Pending SAT
328	6.2.b	Cable installation shall be in accordance with the requirements of STDN-SPEC-6, GSFC Specification Installation Requirements for STDN Equipment	Installation I5	3.6.1	The site prior to installation shall be inspected with respect to cable installation.	Pending SAT
331	6.3.b	Floor panels shall be in accordance with the requirements of STDN-SPEC-6.	Installation I5	3.6.1	The site prior to installation shall be inspected with focus on floor panels	Pending SAT
371	10.1.c	All support spares remaining after Acceptance testing shall be delivered to the WSC site.	Sparing I7	3.8.1	The spares delivered to the WSC site after SAT will be inspected	Pending SAT
378	11.2.a	The DAS IT Security Boundary for Customer control and status shall be at the interface to the SWSI. SWSI security implementation is documented in 452-SP-SWSI, Security Plan for SWSI.	Security I8	3.9.1	The inspection will examine the installation for conformance with the DAS-SWSI ICD. DAS installation has no SWSI interfaces except the DAS-NISN interface at the Smart Hub.	Pending SAT
379	11.2.b	The DAS IT Security Boundary for NISN Closed IONet telemetry delivery shall be at the WSC Closed IONet interface. NISN Closed IONet security implementation is documented in 290-003, IP Operational Network (IONet) Security Plan.	Security I8	3.9.1	The inspection will examine the installation for compliance.	Pending SAT
380	11.2.c	The DAS IT Security Boundary for Internet telemetry delivery shall be at the interface with the NISN Secure Gateway defined in 290-003, IP Operational	Security I8	3.9.1	The inspection will examine the installation for compliance.	Pending SAT

SRD Req ID	DAS Spec Para.	Requirement	Case	A&I Report Section	Verification Approach	Resolution Status
		Network (IONet) Security Plan.				
381	11.2.d	The DAS Physical Security Boundary shall be within the Category II Limited Areas defined in MO&DSD 530-WSC-0009, WSC Security Manual	Security I8	3.9.1	The inspection will examine the installation for compliance.	Pending SAT
382	11.3.a	The DAS connection to the SWSI interface shall be via the Closed IONet only.	Security I8	3.9.1	The inspection will examine the installation for compliance.	Pending SAT
383	11.3.b	The DAS connection to the NISN Secure Gateway shall be via the Closed IONet only.	Security I8	3.9.1	The inspection will examine the installation for compliance.	Pending SAT
289	3.3.4.a	The DAS shall interface with the WSC Systems in accordance with the specifications in the ICD between the DAS and the White Sands Complex.	WSC I/F @ Site I11	3.12.1	There are 46 items identified in Table 3.11-1 that will be inspected and verified at the site with regard to the DAS/WSC I/F	Pending SAT

APPENDIX A: RELEVANT APPROVED WAIVERS

A.1 DAS-D02 Rev 1 (Demodulator Symbol/Decoder Sync)

This waiver is relevant to Analysis Case 4.

Deviation ☒ Waiver ☐

Originator	
Name: ITT Industries, Inc	**Address:** ITT Industries, Inc. 1761 Business Center Drive Reston, VA 20190

Title Of Deviation / Waiver: DAS Demodulator Symbol/Decoder Sync

Contract Number: GS-35-01095, Order # S 87070-Y, Task 11	**Cage Code:** **9M715**

Classification: Minor ☒ Major ☐ Critical ☐

Part Number: 185-600012-01	**Title:** Demand Access System
Effectivity: Serial Number(s): 001	**Recurring Deviation/ Waiver:** Yes ☐ No ☒
Effect on Cost: None	**Effect on Schedule:** None

Effect on Logistics Support, Interface or Software: None

Reference Documents: DAS SRD, spec no. 3.2.4.2.1.8.a & 3.2.4.2.1.8.b

Description of Deviation / Waiver:
Limit the symbol/decoder synchronization time requirement to no less than 50 ms.

3.2.4.2.1.8.a For the minimum symbol and data transition densities and the minimum specified C/No values required for 10-5 PE performance, the time to achieve symbol/decoder synchronization (in seconds) shall not exceed 1100/(data rate in bps), with 99% probability for Biphase symbol formats. For example, a*t 150 kbps this imposes a synchronization time of £ 0.007333 seconds*.

3.2.4.2.1.8.b For the minimum symbol and data transition densities and the minimum specified C/No values required for 10-5 PE performance, the time to achieve symbol/decoder synchronization (in seconds) shall not exceed 6500/(data rate in bps), with 99% probability for NRZ symbol formats. For example, a*t 150 kbps this imposes a synchronization time of £ 0.04333 seconds*.

Need for Deviation / Waiver:

Requiring sub 50 ms symbol/decoder synchronization times (for high data rate users) provides marginal benefit at the expense of significant design impact and cost risk. The benefit from sub 50 ms synchronization time is marginal since PN/carrier acquisition times are on the order of 1 second or more. Sub 50 ms synchronization is potentially very costly because of the stringent real time processing constraints they would impose on the receiver software.

Corrective action taken:

For both SRD requirements, revise the requirement to read: “the time to achieve symbol/decoder synchronization (in seconds) shall not exceed … symbol formats *or 50 ms, whichever is greater*.” This only affects Biphase data rates above 22 kbps and NRZ data rates above 130 kbps.

Submitting Activity

Name:	**Title:**	**Signature:**	**Date:**
Walter W. Kearns	**ITT – AES, DAS PM**	***/s/ Walter E. Kearns***	**02/15/01**

Customer Approval / Disapproval

Approval ☐	**Disapproval** ☐	**Date**
Name:	**Title:**	**Signature:**

ABBREVIATIONS AND ACRONYMS

ACM	Analog Conversion Module
ADPE	Automatic Data Processing Equipment
ADQS	A/D Quad Splitter (Legacy MABE Equipment)
AES	Advanced Engineering and Sciences
AGC	Automatic Gain Control
AGIPA	Adaptive Ground Implemented Phase Array (Legacy MABE beamformer)
A&I	Analysis and Inspection (Report)
BER	Bit Error Rate
BIST	Built-in Self Test
BIT	Built-in Test
CCA	Circuit Card Assembly
CDB	Common Data Broadcast
CF	Center Frequency
CI	Critical Item
CM	Configuration Management
COTS	Commercial Off-the-Shelf
CTFS	Central Time and Frequency Subsystem
DAS	Demand Access System
DCON	DMG Controller
DMG	Demodulator Unit Group
DMU	Demodulator Unit
DPM	Digital processing Module
ECON	EMC Controller
EMC	Element Multiplexer/Correlator
EMI	Electromagnetic Interference
FA	False Alarm
FAT	Factory Acceptance Test
FFT	Fast Fourier Transform
FPD	Front Panel Display
GDIS	GRGT Data Interface System
GSFC	Goddard Space Flight Center
GRGT	Guam Remote Ground Terminal
GUI	Graphical User Interface
HW	Hardware
IBU	Independent Beamforming Unit
IBUG	IBU Group
ICON	IBUG Controller
IF	Intermediate Frequency

IONet	IP Operational Network
I&T	Integration and Test
ITT	ITT Industries Inc.
LAN	Local Area Network
LCM	Local Control Monitor.
LED	Light Emitting Diode
MA	Multiple Access
MABE	Multiple Access Beamforming Equipment
MHz	Megahertz
NASA	National Aeronautics and Space Administration
NISN	NASA Integrated Services Network
O&M	Operations and Maintenance
PVM	Performance Verification Matrix
QA	Quality Assurance
RFI	Radio Frequency Interference
SAT	Site Acceptance Test
SDD	Software Design Document
SGLT	Space-to Ground Link Terminal
SRD	Systems Requirement Document
STGT	Second TDRSS Ground Terminal
SYNCH	Synchronization
SW	Software
SWSI	Space Network Web Services Interface
TDP	Technical Data Package
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TGBFS	Third-Generation Beamforming Subsystem
TH	Threshold (for Threshold Detection)
VPT	Verification Planning Table
WSC	White Sands Complex
WSGT	White Sands Ground Terminal